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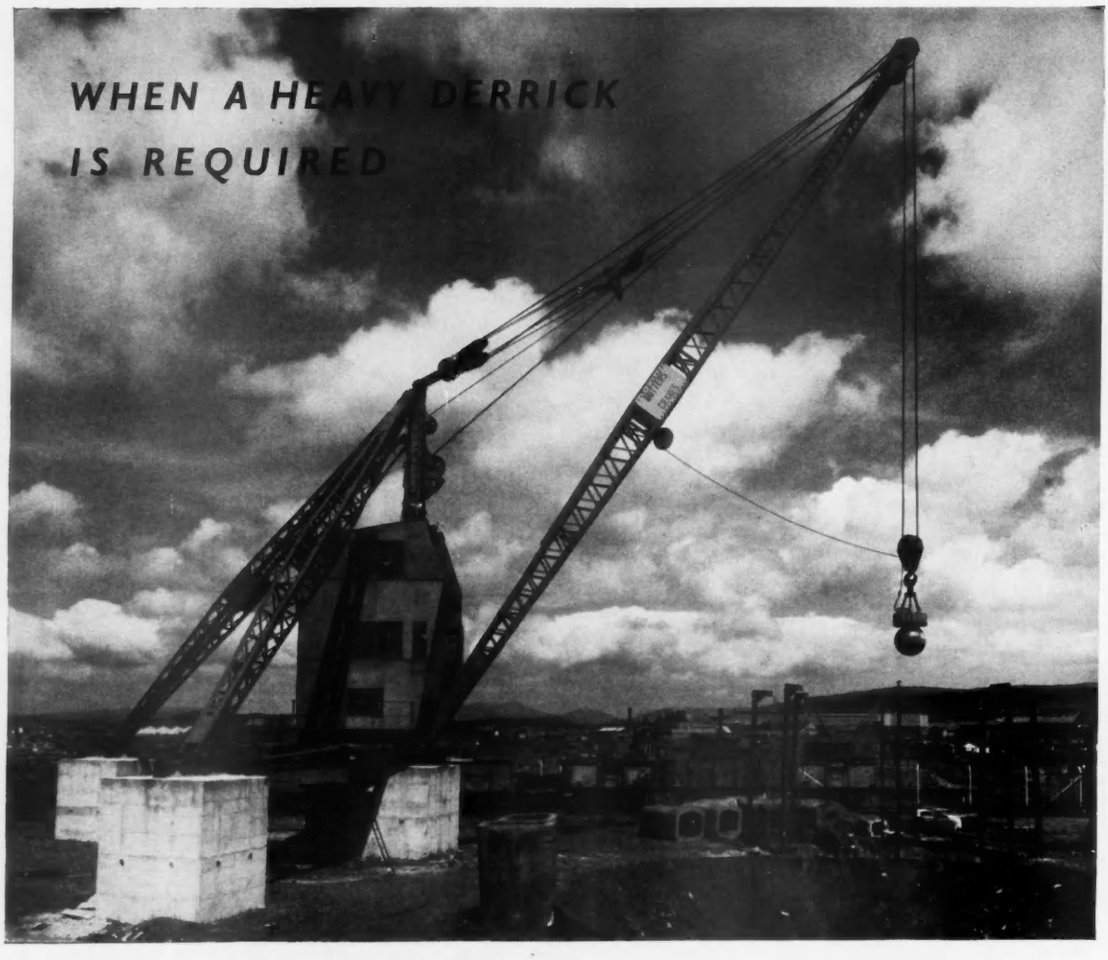

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ENGINEERING

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ENGINEERING *Appointments Section faces page 676*

Men, Money and Jets

GREAT is the ferment in the aircraft industry. Within hours of Mr. Duncan Sandys, the Aviation Minister, putting his views on the concentration of the industry to the council of the Society of British Aircraft Constructors, the proposed merger of Hawker Siddeley and de Havilland was announced. While this news was on its way into the papers a particularly clear view of the industry's future was being put to the Institution of Mechanical Engineers by the technical director (aero) of Bristol Siddeley Engines, by Dr. S. G. Hooker.

The Viscount, Britannia, Hunter and Canberra, all contributors to the oversea earnings of the industry, now mounting towards £1,000 million since the war, are becoming obsolete. Can exports, even with the mount-success of British aero-engines, be maintained on this scale? Because disaster robbed us of the commanding lead the Comet could have achieved in pure-jet passenger transports, the Americans and the Russians are now alone in the big-jet league. The Comet 4 is a brilliant smaller brother with what may be a good commercial future as the medium-range so called Viscount-replacement aircraft.

But the aircraft industry has always depended for maintaining its productive size, as well as its research, upon Royal Air Force and defence orders. Without these, and Government research and development contributions, the British aircraft industry, as Dr. Hooker carefully underlined, is in danger of being put out of the race by their government assisted rivals in the United States and the Soviet Union.

Mr. Sandys is a man who will unmistakably make a mark on the industry. Whether for good or ill depends on a number of things. First among them is this matter of money. So far it is rumoured that greater financial help may be expected than from his predecessor. After all, did not Mr. Macmillan, the Prime Minister, say before the election that the problems of the industry would have to be met? Mr. Sandys believes in reduction. While he was at the Ministry of Defence down came the size of the armed forces. He has said there are too many aircraft companies—"chasing too few orders." More or less by undenied repetition it has become accepted that he would like to see just two big airframe firms and two large aero-engine makers.

This would give the sort of base from which fund raising in the City would be easier than if there were three or more main firms in each division. It is a short step from there to the thought that concentration into two pairs would reduce the amount of money the Government might have to provide while maintaining just enough of competition to refute the nationalisation proposals of the trade unions and some members of the Labour Party.

Concentration into a very few large units may render precarious the situation of the many small firms providing the big companies with fittings from cable clips to crew seats. For the moment, the amalgamation of the highly diversified Hawker Siddeley group and the de Havilland concern appears to be a step bringing nothing but strength to British airframe and engine manufacture. It is to be hoped that within the large groupings lines of inquiry will not be too few. For decisions taken in the near future on the type of aircraft to go on into the Mach 3, 2,000 miles an hour speeds and above will go on to success or failure at a rate that will not allow for second thoughts. Wrong decisions at Ministerial or board room level could cost the industry a great deal.

The men who have to shape these policies are entitled to know that the industry about them has been brought into a stable pattern and that necessary work will not be scrapped for lack of money, private or public.

Aircraft are not produced by money and research alone. If the Government are concerned to assist the industry it could well look to a more rational policy in deferment of engineers from National Service. At the moment if the graduate or the man who has completed his apprenticeship goes into the research department of a big firm he may not be getting broad and valuable experience as an engineer but, subject to the sort of work the company is doing, he is reasonably certain of being deferred. For all the none-too-early enthusiasm for research, production demands quality and the guiding hand of engineers if the costly inspirations of the research teams are to amount to anything. Yet it is all too well known among science and engineering graduates that they have in reality only two choices—between a research posting and "the Army or the mines."

The effect of this is to rob production departments of large concerns, and of small firms altogether, of the much needed services of the graduate engineer. It also has the effect of drastically limiting the number of engineers who have the double-barrelled advantage of academic training plus the all-round experience gained in the smaller companies.

Mr. Sandys is alert to the problems of the aircraft industry. Mr. Edward Heath, Minister of Labour, could lend a hand, too.

Cover Picture.—*Milling slots for the compressor blade carrier rings of an aircraft turbojet gas-turbine.*

(*Nurnberg photograph for* ENGINEERING)

Plain Words

Where is the genius who can show us the way out of the Christmas card impasse?

On your return to the office after the Christmas break, you may well wonder whether it was all worth the time and expense involved. And as you shovel them up perhaps you put the really splendid ones aside with a vague idea that there must surely be some more worthy fate for such creations than the waste-paper basket. That is exactly what I did last year—and they collected dust in a drawer until I cleared them out a few weeks ago.

The Christmas card system has been going for about a hundred years, although it was in 1843 that Sir Henry Cole, finding himself pushed for time just before Christmas, gave up his annual seasonable letters to his friends and sent them cards which he had commissioned an artist to design for him. Post Office records show that the number of letters and cards posted during the Christmas period has been increasing even in the past ten years—from about 550 million in 1949 to an estimated 900 million this year. There is no sign of a flattening-off in the curve.

Thanks to Sir Henry, and the enterprise of the commercial firms who have developed his idea, we now have the most extensive you-scratch-my-back, I'll-scratch-yours operation in the history of civilisation. We all feed each other's self-esteem.

A lead to other firms has, of course, been given by David Brown, Shell, Ford Motor and a few other large companies who have stopped sending cards. One of the nationalised industries, which shows a loss on its annual accounts, has not sent out cards for the past few years.

I have considered the possibility of going back to the pre-Cole practice and writing personal letters. It would be feasible in the case of one's closest friends but an alarming task for business purposes. A hitherto-untried (as far as I know) idea would be to use one of those cunning typewriters which automatically types any combination of sentences or paragraphs you have already fed into the machine. The plan would be to concoct about half a dozen different paragraphs so that they could be selected and arranged to suit all your friends. For example, one for the man who always sends you a case of spirits; one for the man who ought to send you a case of spirits; one for the man who used to send you . . . and so on.

As a recipient, however, I find there are two types of cards which really give me pleasure: the card which also carries a personal handwritten message, and the card which benefits a charity.

CAPRICORN

Weekly Survey

British Engineering on Broadway

So great has been the demand of the engineering industries for space at the British Exhibition to be held in New York in June, 1960, that the industrial section has overflowed from the third floor of the big Coliseum building to take up a third of the second as well.

Predicting in London last week that a record export to the United States from Britain of $1,000 million worth of goods was all but certainly achieved this year, Lord Rootes, the motor chief who heads the Dollar Export Council, declared that the British 1960 exhibition would be the first time the four-storey Coliseum building will ever have been used in full for one show. The Soviet exhibition in June this year caused quite a stir but spread over only two and a bit of the floors.

The American way of numbering storeys makes our ground floor their first, our first their second and so on up, but the fact still remains that the bulk of the individual British engineering firms' stands will be on the third (our second) floor. Since lists of exhibitors are not yet available this raises some doubt as to whether the term heavy is merely relative and perhaps not quite what is assumed to be "heavy engineering."

Mr. W. P. N. Edwards, managing director of British Overseas Fairs, who are arranging the whole £3 million affair, assured ENGINEERING that with a floor loading of 200 lb a sq. ft on the third and 300 lb on the second, heavy engineering exhibits will be possible. The overflow of engineering firms from third to second, a floor originally planned to be entirely given over to "high-class consumer goods," is evidently a result of the speed with which the industries' managers saw the opportunities offered by the New York 1960 exhibition.

Now under the patronage of the Queen and of President Eisenhower, the exhibition gives the entire ground floor of the Coliseum building to a scene setting, still hush-hush, British Government exhibit by the Central Office of Information. The set will come from the same hands that did so well at Brussels. Shipbuilding, the iron and steel industry, the Royal Mint (who have a wide export business in coins), the BBC, Lloyds, the London clearing banks, and the British Travel and Holidays Association (in association with BOAC and BEA), all plan full-scale prestige exhibits on the ground floor.

Mr. W. H. McFadzean, president of the Federation of British Industries, has explained that the great lesson of the successful Lisbon exhibition was that it enlisted the support and sympathy of the people and President of Portugal by being as much a festival, showing culture and tradition, as a trade fair. With this in mind, the show at the Coliseum, with its entrances from Broadway, will have the whole top floor given over to traditional English pursuits like the garden, the pub and Scotch whisky. The barmaids will be English, although the waiters will be American.

Not far off, at Madison Square Garden, a British military tournament and tattoo of suitably super-colossal proportions is to be put on by every kind of ceremonial service unit from all five regiments of the Guards, Household Cavalry trumpeters, the Royal Marines, and dancers from Scottish Highland regiments, to the Royal Signals motor cycle display team. This should give the publicity men something to work on.

From London, six months ahead of the opening, the guess is made that at least 500,000 people will see the exhibition, and of them perhaps 25,000 will be trade buyers. The exhibition is strategically timed: just before and it would have missed the great influx of Americans and foreigners into New York, just after and the great city might be in the grip of heatwaves.

British trade in America has a permanent ambassador in New York, in the person of Mr. L. J. N. ("Jerry") Blyde, manager of the British Trade Centre and a tireless worker in a land where it never pays to be tired.

Portuguese Prospects

Portugal is the only one of the seven nations in the European Free Trade Area (the Seven) who may be described as a backward territory. She was not included in the tariff figures for Western Europe issued in detail by Political and Economic Planning earlier this month.

But her government has a plan, or rather a second *Plano de Fomento*. It is for the investment in Portugal and her overseas territories, particularly Angola, of £375 million. Some £70 million is described as "foreign financial contribution."

Under this heading comes the proposed bridge across the Tagus, which the Portugese hope will be built entirely on foreign credit. The now forming National Development Bank is a necessary instrument of progress and one of the most direct needs that have brought about its formation is the handling of foreign or international credit. With an eye to the spread to her own poverty ridden people of the general consumer-expectancy Portugal has asked to be admitted to the International Monetary Fund and the World Bank's international reconstruction and development bank.

But Portugal's membership of the Seven does not automatically mean that British industries will get the benefit of international funds made available for the modernisation of Britain's ancient ally. The Portugese Minister of Foreign Affairs was recently in Bonn discussing with senior West German officials the best way in which the two countries could collaborate in the development of Angola and other Portugese overseas lands.

As Portugal's traditional dislike of foreign industrial and financial activity within her borders withers before modern pressures it will certainly have interesting political effects. It will need imagination and personal representation following up the Lisbon fair to see that our 400-year-old friend uses British firms and equipment and not those from the European Common Market in at long last beginning to enter the 20th Century.

Cutting out Customs

Trans-continental lorry journeys by British operators will become very much less troubled with formalities from next month (7 January) following the ratification by the Government of the Customs Convention on the International Transport of Goods under cover of Transport Internationale Routier (TIR) carnets.

The present system involves road vehicles and containers being examined by customs officers in the exporting country and at every frontier crossed on the way to the destination. Goods sent under the TIR convention will normally be examined by the customs only at the country of origin and on arrival.

Since the TIR carnet is also ranked as a bond the carriers of participating countries will not be subject to the payment or deposit of duties en route. Vehicles that are to be used under the Convention must fulfill its technical conditions and the approving authority for the United Kingdom is the Ministry of Transport.

The countries to which British hauliers will be able to go under the Convention are: Austria,

Belgium, Denmark, France, Western Germany, Italy, Luxembourg, Netherlands, Sweden and Switzerland.

Full particulars of the approved scheme and of authorised organisations able to issue the carnets are obtainable from the Ministry of Transport or any Traffic Area Office.

Steel Records Going Higher?

The steel industry, still smarting a little from the sharp reminder from Luton of the gap between production and demand, at least in the car industry, has exceeded its record level of production and looks set to do even better.

The November weekly production, averaging 458,600 tons, was more than 15,000 tons a week better than the previous record of 443,200 tons in May, 1957. It was just over 17,000 tons above the figure for the previous month.

Expanding deliveries to not only the motor car industry, but to all the engineering industries and to building and constructional works, included larger deliveries in October compared with September in sheet plate and to heavy engineering.

If the merchants and consumers who have been running stocks down—and in the third quarter they dropped by an appreciable percentage more than the customary average of 148,000 tons—have started stockbuilding again in the last weeks of the year, then even better figures should be along in the New Year.

It is interesting to observe that while industrial production over all industries is estimated to move up by 2 per cent in the last quarter of the year over the third, in the metal using industries alone, after the big increase of 2·2 per cent between the second and third quarters, only a 0·1 per cent increase is expected between the third and fourth quarters.

Steel production in the third quarter, 12 per cent above the output of 1958's third quarter, is estimated for the last quarter of the year as 25 per cent above the same period of the year before. Steel consumption, comparing 1959 and 1958, has jumped by 2·8 per cent in the third and is expected to have risen by 14 per cent in the last quarter.

Ten Guineas Well Spent

The New Year will see the death of that valuable digest of information for those who trade abroad: the Board of Trade's Special Register Information Service.

After half a century of life relaying details of calls for tender by oversea local authorities, of foreign firms seeking United Kingdom suppliers, of the whole field of export opportunities, the Special Register is to be replaced from 1 January by an *Export Service Bulletin* that will appear three times weekly. Published on Mondays, Wednesdays and Fridays, the *Bulletin* will bring a new urgency to spreading in industry the latest oversea information. It will be assisted by a special Mondays-only economic conditions and market commodity report from British commercial, trade commissioner and diplomatic services abroad.

The new *Bulletin* is said by the Board of Trade to be the solution to the problem that has arisen as the pressure has grown on the more than 50 years old Special Register. Much greater volumes of oversea commercial information are expected in the next decade and the new publication looks like being a sound way of speeding up its distribution.

Since 1952 the subscription has remained steady at £2 10*s* a year despite the obviously large increase in costs over the last eight years. The new annual subscription will be £10 10*s* (post paid), though extra copies at the same address will be only half price. It is difficult to see how a serious competitor in the increasingly keen export markets could expect to do without the Board of Trade's *Bulletin*. If there are criticisms or suggestions for improvement the department would be glad to hear them.

Trade Fairs and Eastern Germany

At the close of the year the Chamber of Trade of the German Democratic Republic has given a summary of exactly what a year's enterprise at international trade fairs means to one country.

The fairs concerned are the two at Leipzig and those at Milan, Paris, Poznan, Zagreb, Vienna Brno, Stockholm and Tunis. Presidents and Prime Ministers visited the East German stands, perhaps partly because this was the tenth anniversary year of the state.

The Milan fair gave the GDR fresh agreements and substantial contracts with the Italian chemical industry. Some 220 million roubles was the estimated value of contracts which came from the Brno international fair. Arrangements with firms in Africa were set up at the Paris exhibition.

The St. Eriks fair in Stockholm brought 10 million roubles in contracts to GDR exhibitors and almost twice as much business was done at Damascus. In Zagreb the total was well above 50 million.

No figures are available for the outcome of the fair at Poznan, but increased trade between East Germany and Poland was agreed at a meeting in Berlin recently, providing for GDR deliveries of a variety of chemicals and manufactured goods, including mopeds and cameras. Poland will be sending in return, coal, zinc, certain chemicals, electrical apparatus and self-tipping railway goods wagons. The level of trade between the two countries will be considerably advanced above that set out in the agreement of 1958.

Looking ahead to trade fairs of 1960 the Leipzig fair authorities are able to announce that the Iraq Republic intends to be an exhibitor.

Alcoa Developing Surinam

Anyone asked what is Alcoa, and where is Surinam, would probably find the first part of the question easier than the second. The Aluminium Company of America was well known in Britain even before it hit the headlines at the turn of the year. Surinam, formerly known as Dutch Guiana, comes into the picture because of a vast new development scheme that Alcoa is just starting there. The project will cost $150 million and will make Surinam the world's fourth biggest aluminium producer, following Brazil, Canada and the United States. It involves building power dams, hydro-electric installations, and a new aluminium smelter. The work will be carried out as a joint undertaking by Alcoa and the Surinam government. It is forecast that within 12 years of the smelter coming into operation, or by 1972, whichever is the sooner, the company will also build a bauxite refining plant for processing red bauxite ore into white alumina. Alcoa has been shipping bauxite from Surinam since 1922. At the present time about 60 per cent of Alcoa's needs come from there, with a further 25 per cent from Arkansas and the rest from the Dominican Republic. About 4 tons of bauxite are needed to produce 2 tons of alumina which in turn make one ton of aluminium.

Most of the output of the new smelter will be sold in Europe. And the decision to develop Surinam was made largely because of Alcoa's growing interest in foreign sales. One possibility that will be watched closely is the prospect that Surinam because of its position as a semi-autonomous possession of the Netherlands may be associated with the European Common Market. This would give it a competitive advantage over Canadian and some West African aluminium producers. This question of the favourable position of overseas territories included in the Common Market is one that is likely to give considerable trouble in other areas besides Surinam in the future.

Letters to the Editor

THE WAY OF THE WIND

SIR, If Mr. C. S. Durst's article on "Duration of Wind Loading on Buildings" (ENGNG., 27 Nov. '59, p. 550) had been published ten years ago it might have qualified as an up-to-date survey, with one major inaccuracy, of the available knowledge of winds. Now, by ignoring entirely the great advances which have taken place, in that time, in our understanding of the effects of stability and topography on the air stream over the ground, he has given a picture of the subject which is unbalanced and, in places, downright misleading.

That is surprising, because much of this modern work has been published in the same meteorological journals which Mr. Durst quotes previously to his own references; and it is a pity, because there was certainly a need for an article on the subject. Also, the general survey of the structure of the wind and its effect on buildings, will, no doubt, be useful to civil engineers.

In the first part of the article there is only one point which strikes me as not being made clear, and that is not important if generous "funk factors" are used in its application. This is the fact that the maximum gust increment does not necessarily occur at the highest wind speeds. The relationship between turbulence and wind speed is probably some function of the atmospheric stability, but anyone who has done much slow flying at altitudes of a few hundred feet can remember days of frightening roughness when the wind speed was only 30 m.p.h. or so, and, at other times, smooth gust-free conditions in much stronger winds.

In the section on the effects of topography, however, the descriptions and interpretations given of the wind variations over and downstream of hills and valleys is neither accurate nor complete, in the light of present-day knowledge. To begin with, the statement that the question of air speeds on hill slopes is largely unexplored is just not true. There is a great amount of qualitative information possessed by hill-soaring glider pilots, many of whom are skilled observers and can give reliable figures for the horizontal and vertical components of the wind speed, at least over the forward part of the slope.

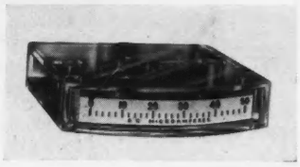
Not even this practical experience is needed, unfortunately, to see the impossibility of the airflow depicted in Fig. 3. Although the point, made in the text, about the ratio of speed at the crest to that in the plain, may not be much affected, the streamlines in Fig. 3 imply a ratio of over 4 : 1, not the value of 1·25 : 1 quoted. Also, on the scale shown, the upper streamline could not be undeflected by the hill, and at least this figure should be made to show normal aerodynamic flow over a smooth obstacle, with the streamlines affected up to a height of between two and three times that of the hill. Even so, it is only lesser undulations, or the lower of the chalk Downs, which are so well streamlined as to have no breakaway of flow; and the steeper hills of this country, such as grit stone and limestone, to name only two, are well known for the curl-over, or separated flow, behind the crest. In this region, often a few hundred feet across, the wind speed close to the ground is reduced, and usually reversed close to the crest itself, while there may be violent gusts where the flow re-attaches to the ground.

These are minor points, however, compared with the effect of atmospheric waves on the wind over hills and downstream of them, which is now quite well understood; again owing to the observations of the gliding fraternity and the theoretical work of a very small number of meteorologists and mathematicians. The fact that the air stream can be disturbed up to a height of 20 times that of the hill, or more, is not relevant to this discussion, but the preponderance of waves on the lee side of hills, and their interaction with other hills further downwind, gives rise to wind variations differing greatly from those of simple aerodynamic flow.

Continued on the next page

MINIATURE METER

Edgewise Mounting



MODEL 220 is a miniature meter for mounting edgewise in a panel.

The meter incorporates a miniature version of the Taylor centre-pole movement which is claimed to be very robust and to have a permanent method of dry balancing, small size, light weight, and stick free operation.

The same size instrument can be supplied as a voltmeter, milliammeter, or microammeter and all ranges can be supplied with a rectifier for operation on alternating current supplies. Models are also available with the zero at the right or left, at the centre or displaced to one side. There are versions for mounting either horizontally or vertically according to layout requirements on the metering or control panel to which they are to be fixed.

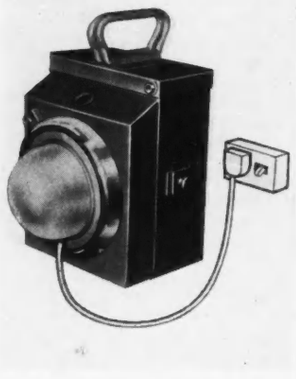
The housing is a transparent case allowing a maximum amount of light to fall on the scale which is said to result in a shadowless reading. The frontal area required is only 2·5 in by 0·62 in, which is claimed to be less than a quarter that of other meters of corresponding scale length.

The makers report that the meters are particularly useful on control panels, as several can be mounted one above the other, without there being any mutual interference. Such an arrangement is useful for computers and multi-channel installations as it offers the advantage of being able to compare readings directly.

The miniature movement of the centre pole design is inherently shielded so that readings are not affected by the proximity of other meters, ferrous materials, or stray magnetic fields. It is especially claimed for the case that it is suitable for incorporation in transistorised assemblies that have to be plugged in as complete units. *Taylor Electrical Instruments Limited, Montrose Avenue, Slough, Buckinghamshire.*

STAND-BY LAMP

Rechargeable Battery



THE portable standby lamp illustrated contains a nickel cadmium battery which will give continuous light for 20 hours in the event of mains failure.

The unit, the RE6, comprises a 6-cell Nife battery contained in a steel case finished in enamel with a lid and carrying handle. The bulb holder takes a double filament bulb with the filaments rated as 3 watts and 18 watts. A domed glass gives good light distribution.

To give the stand-by operation a relay unit is mounted in the front which is normally kept open while the lamp is plugged in to the mains but which closes on mains failure and connects the 3 watt filament to the battery. If additional light is required, the depression of a switch connects the main filament. With the latter in use the battery will give 3 hours running before recharging is needed as against the 20 hours of the 3 watts filament.

For recharging the battery a supply of 1·5A at 8 to 10V is required, which is given by most industrial chargers. The lamp measures 9 in high by 8 in wide by 7½ in long and weighs approximately 13 lb. Particular claims are that there are no installation costs and that the battery is virtually free from self-discharge so that the lamp will remain in working order for a long time without attention. *Nife Batteries Limited, Redditch, Worcestershire.*

TESTER

Roundness and Straightness

THE Hommel measuring machine for checking the roundness, parallelism and straightness of cylindrical specimens is now available in this country.

Chief claims are that the instrument uses only one stylus for all measurements; gives a full three dimensional picture of the component and has an automatic centring mechanism that reduces the time of setting up. Work up to 6 in diameter and 8 in long can be handled with a maximum magnification of 10,000.

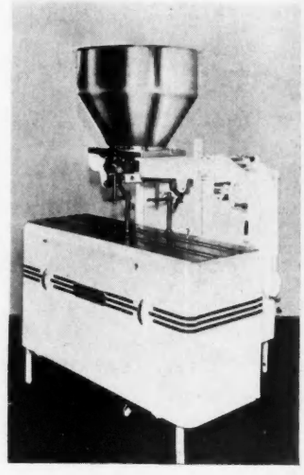
The equipment consists of four parts: the mechanical testing apparatus; the graph recorder; the control unit; and the viewing equipment. The mechanical testing apparatus consists of a high precision turntable with clamps that give a preliminary centring. The contours of the cylinder are traced by an electrical system fitted to a slide that moves on a vertical column forming the reference line. The column can be adjusted to approximate the specimen diameter and the final adjustment is automatic. The tracer arms are interchangeable to allow for internal and external measurements. The smallest bore that can be measured is 0·120 in.

The recorder consists of two instruments for polar and longitudinal records. The magnification range is from 100 to 10,000. The control equipment provides the automatic centring of the specimen after it has been held by the clamps.

The viewing equipment is a cathode ray tube on which the automatic centring process can be followed and on which the polar diagram appears. The recording of the polar errors is therefore not always necessary. *Rubert and Company Limited, Acru Works, Demmings Road Councillor Lane, Cheadle, Cheshire.*

CAN FILLER

Adjustable for Size



THE new Colton-Hope can filler is arranged for two line production and is adjustable for can sizes from ¼ oz to 1 quart.

The machine will take cans, bottles, jars, or paper cups with a six inch height variation. Production rates are from 20 to 60 cans per minute according to size.

The height is adjusted by a hand wheel, and a rising table permits bottom filling of the containers. All the operating mechanism is enclosed and clear of the product zone. A feed bar type conveyor moves the containers along swiftly and smoothly while a "no-container no-fill" device prevents spillage if a container is not under the head. It is claimed that the diagonal position of the containers gives handling advantages and conserves space.

Power is provided by a ½ h.p. motor through a variable speed drive. A micrometer type adjustment permits accurate feed settings and the fill accuracy of the machine is given as within one-half of one per cent. The hopper holds 80 quarts. *Arthur Colton Company, Export Department, 13 East 40th Street, New York, 16, NY, USA.*

Concluding Letters to the Editor

Because the formation of waves, with or without trains of lee waves, depends on a number of variables, the most important of which appears to be the profile of l^2 with height, where l^2 is a factor directly proportional to the stability and inversely proportional to the square of the wind speed, the combination of these with the local topography can give rise to a wide range of possible air flows. Probably only local knowledge and lore extending back over many years can be used to outline the greater variations of wind speed at any particular site, but the point is that these variations should be expected more on lee slopes than on upwind slopes, and that, especially at night, wave motion is commoner than simple flow over the hillier parts of the country throughout the year. Much of the literature on waves is contained in meterological and gliding journals, but for a general description of the subject the two references given below are probably the most useful.

This knowledge of waves throws a completely different light on the valley winds discussed in such detail by Mr. Durst, because the phenomena at Milfield are far better explained by the type of flow known as rotor-streaming, which is analogous to hydraulic jump in a water channel, than by the concentrating effect of a valley. I do not know the locality personally, but a study of a map of the area shows the valley of the River Glen to be a far less dominant feature than the Cheviot itself, over 2,700 ft high, and a dumbbell shaped ridge extending north from it, which lie five or six miles further west. In a south west wind suitable for rotor-streaming a very high velocity and shallow layer of air would flow down from this ridge towards Milfield, and this exactly fits the description given by Dr. Jane Meiklejohn; there should also have been a turbulent rotor, possibly marked by a bar of cloud, at about 3,000 ft over the mouth of the valley. The nature of the flow can easily be checked when the weather conditions are suitable by any observer who is sufficiently interested.

This is not to say that valleys do not have an effect in increasing local wind velocities; they obviously do, and I have vivid and uncomfortable memories of flying into the side of such a jet which was blowing out of the Ladybower Reservoir valley across the Hope Valley, in Derbyshire. But I feel that it is not a dominant factor, and it may, in fact, be dependent on wave forming conditions; certainly waves were forming in a northerly wind on the occasion I described above.

For the man on the ground, the practical effect of all this is that exceptionally violent winds may not only be found in valleys which run down to the east of hills. They may occur on the lee slope of any major hill or ridge, with strong winds from any direction; in fact, one of the most famous is the north easterly Helm wind in Cumberland, and its associated rotor over the Eden Valley. Again, if the greatest wind on the site is significant, local lore and practice will show the way.

Yours faithfully,

PETER RIVERS.

Redwood, Waterside,
Marple, Cheshire.
8 December, 1959.

References

Scorer, Dr. R. S., *Natural Aerodynamics*, Pergamon Press, London.

Corby, G. A., *Air Flow Over Mountains*, Meteorological Report No. 18, HMSO, London.

VIBRATORY CONVEYOR

For Low Head Room

A NEW vibratory conveyor has been added to the Sinex range.

The particular advantages claimed are that it requires very little head room, that it can be used in hot operations where some other types cannot, and that, having few moving parts, it requires very little maintainence.

Power is supplied by two rotating vibratory units mounted one on each side, which rotate in opposite directions so that horizontal vectors are cancelled out leaving vertical components only. By inclining the units relative to the conveyor table, these vertical movements can be used to throw the material into the air, while the table performs a simultaneous small horizontal movement. Thus the material is moved along. The vibrators rotate at 3,000 r.p.m. giving a virtually continuous flow of material.

The conveyors are made in sizes up to about 14 ft long, but larger ones are being developed. They can be up to 4 ft wide. One of their advantages is

that they will handle very large flows and the rate of flow can be adjusted by altering the angle at which the vibrators are set. This is usually 20°. The vibrators are totally enclosed and no moving parts are exposed, making the conveyors safe as well as largely dust proof. Ball and roller bearings are used throughout.

The conveyors are normally supplied complete with base structure, but they can also be supplied with simple mountings to suit the customer's requirements. The vibrators can be replaced if necessary by removing them from their four bolt lug mountings. The feed can be controlled by the addition of an electric feeder unit. Applications cover a wide range from plastics chips for recording discs to onions which pass along an open conveyor for sorting. *Sinex Engineering Company Limited, North Feltham Trading Estate, Feltham, Middlesex.*

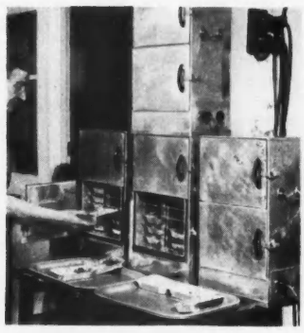
TRANSPORT CONTAINER

Electrically Heated

TRANSPORT containers have been developed which can be kept hot on route by low voltage heating.

The containers were originally designed for the transport of hot meals by road vehicle for a communal meals service, and replace older forms which relied on hot water jackets. Delays on route often caused the food to be cold on arrival, and in any case the containers were heavy to handle.

The new containers are made of light alloy. There are two sections with separate doors, each taking 10 meals in foilpak dishes standing on separate racks. At the canteen, and while the containers are being loaded, they are heated from the mains supply using a 250W element. When the containers are transferred to the delivery van they are plugged into a battery supply at 12V which works a separate 40W element. All the electrical apparatus is mounted in a tray at the bottom which allows easy servicing, and the two elements are connected to dissimilar plugs so that



there is no risk of the wrong supply being connected. A pilot light in the vehicle glows to show that the units are plugged in.

Heat is maintained within the containers for about three hours which is sufficient to allow for ordinary traffic delays or even for a minor breakdown. It is stated that the vehicle batteries need charging only every fourth day. *General Electric Company Limited, Magnet House, Kingsway, London, WC2.*

AIR DIFFUSER

Adjustable Discharge

THE Kno-Draft air diffuser is fitted with an adjustable ring that allows the direction of the discharge to be altered to suit the conditions in any special installation.

The periphery of the outer stationary cone is provided with an air deflecting rim shaped to give an even discharge; the inner element of the diffuser is adjustable up or down.

It is the position of this inner cone that determines the direction of the air flow. Any pattern of flow from fully vertical to fully horizontal can be obtained from the one diffuser and adjustment of the direction may be made after the unit has been installed.

The design of the unit allows the control of air volumes without altering the pattern of the diffusion. This adjustment can also be made from within the room.

In addition, the body design allows the fitting of a lighting fixture in the centre of the unit which when the latter is mounted on the ceiling avoids over-

crowding and the nuisance and unsightliness of many projections. *Ozonair Engineering Company Limited, The Esplanade, Rochester, Kent.*

DIE CASTING MACHINE

Simple and Inexpensive

CHIEF claims for a new gravity die casting machine are that it is simple to operate and that it uses inexpensive dies.

The machine has been designed to reduce both the capital and the running costs of producing iron and light metal castings which do not need to be made to within very close dimensional tolerances.

There is a two way cylinder for closing and clamping the dies which is operated by compressed air. The die heating and cooling arrangements of conventional machines are not required as the dies are made in a grade of Meehanite to withstand thermal shock, and the machines are used in banks of sufficient numbers to allow time for natural cooling between pourings.

For making iron castings of about 3 lb weight, the dies require a cooling time of about 4 minutes. In this time it is stated that two operators, one pouring and the other removing the castings, can tend a bank of 15 machines turning out

225 castings per hour using natural cooling as mentioned above.

Dies are designed by the Efco company to customers' drawings and supplied ready for the machine. They are made by the " true-to-form " as-cast technique which is a much cheaper method than machining and may be as low as one-quarter the cost.

The machine has an overall length of 3 ft 10 in and is 9 in wide. It is said to be at a convenient height for pouring. It will accommodate dies measuring up to 10 in by 8 in face area. A bank of five machines, allowing for gangways and room for stillages or bogies, occupies a floor space of about 8 ft by 8 ft. It is claimed that the machines can be operated without previous experience of die casting work. *Electric Resistance Furnace Company Limited, Netherby, Queens Road, Weybridge, Surrey.*

COLLETS

Permit $\frac{1}{8}$ in Material Tolerance

THE range of Multisize collets made by Burnerd's has been extended, and adaptors are now available for all types of lathe.

The great advantage of these collets over the standard spring jaw type is the permissible variation in bar size that they will accept. For a spring collet the limit is about 0·006 in; for the Multisize collet the range is $\frac{1}{8}$ in for each size. Thus it is claimed that one Multisize can take the place of at least 10 spring collets.

Concentricity is another claim. Since the adjusting bars grip the work over their full length, there is no tendency for the work to tilt. An accuracy of 0·0005 in is guaranteed close to the collet and the concentricity is maintained to $\pm$ 0·001 in 4 in away. A group of six sizes makes up a range covering bar diameters varying from $\frac{1}{16}$ in to $2\frac{1}{2}$ in.

The collets are made for round, square, or hexagonal bar, but each model of the same capacity has the same external

size; it is therefore necessary only to have one set of six holders to accommodate all the varieties.

To mount the collets in various machines, there are lever operated dead length chucks; key operated chucks; and table mounting chucks for holding vertical work. One form of the last type has the key spring loaded so that it cannot be accidentally left in position. *F. Burnerd and Company Limited, 5 Balfour Place, Park Lane, London, W1.*

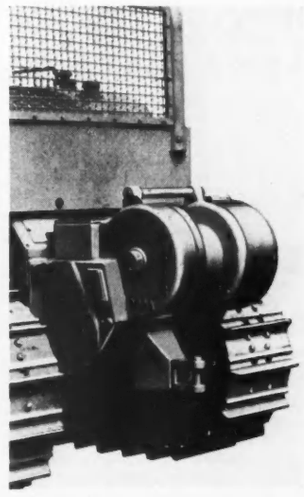
TRACTOR WINCH

Hydraulic Control

A POWER controlled winch is now being offered as an attachment to Caterpillar D8 and D9 tractors.

The system is hydraulic and the winch is available in normal and Lo-Speed models. The latter can be run to give line speeds down to 23 ft per minute. Both can be used with power shift tractors. The winches can also be fitted on series D D9 tractors and series D to H of the D8 version, with either direct or torque convertor drive.

It is stated that the controls are easy to reach and operate, needing an effort of only 8 lb. A single lever provides automatic brake release while engaging clutches. An inching brake lever is fitted. Hydraulic power is supplied by a gear pump driven from the tractor lay shaft and the winch can therefore be operated at any time while the engine is running. There is a pair of multiple disc oil cooled clutches, which do not require adjustment during their life. The differential brake is self energising. Extras include cable guide rolls and a



fairlead assembly, and there is a choice of standard fixed or swivelling draw bar. *Hyster Company, 2902 N.E. Clackamas Street, Portland 8, Oregon, USA.*

DIRECT ACTING WATER PUMP

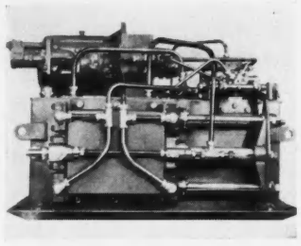
High Pressures

AN addition to the Sutcliffe range of mining equipment is a direct acting water pump for supplying water at pressures up to 1,000 lb per sq. in.

The pump unit is self-contained with an electric motor driving a rotary oil pump which supplies oil at high pressure to two double-acting cylinders, the pistons of which are connected to a yoke. This in turn is used to drive the piston of the water pumping cylinder.

As the oil cylinder is fitted with an automatic instantaneous reversing valve, it is claimed that the delivery of pressure water is kept practically continuous and unvarying in quantity. The whole unit is mounted on the power pack to form one item that can be moved as a whole. In the mine this enables it to follow the coal face as it is advanced.

The pumping equipment consists of a galvanised tank that will hold 100 gallons of water or mixture. On the tank cover is mounted a 7½ h.p. electric motor running at 1,500 r.p.m. It is this



motor that drives the oil pump. The ram driven by the pump will reciprocate at such a speed as to cause the water ram to deliver up to 5 gallons per minute at a pressure of 1,000 lb per sq. in. For protection, relief valves are fitted in both the oil and the water circuits. A pressure gauge in the water line shows the delivery pressure.

The makers state that a typical use for the unit is to supply rams on armoured chain conveyors, using a mixture of mine water and soluble oil, the latter being added to reduce corrosion. *Richard Sutcliffe Limited, Universal Works, Horbury, near Wakefield, Yorkshire.*

FLUORESCENT LIGHT

Portable and Adjustable

THE type A 130 fluorescent light is a portable unit for general lighting and inspection work.

The lamp is mounted on a tubular stand which is adjustable for height from 3 ft up to 6 ft, a clamp holding the extension piece in the desired position. The lampholder is mounted on a swivel on the top of the stand and can be swung through 90° so that it can lie anywhere from vertical to horizontal. It can also be tilted to throw the light up or down for horizontal surfaces.

The column is fixed to a tripod base fitted with large diameter rubber tyred castors which enable the whole to be moved easily from place to place. The base is made very heavy to avoid the lamp being accidentally upset. It is said to be perfectly stable in every position of the lampholder. All the control gear required for the fluorescent lamp is contained in a metal case at the foot of the column. The same case also holds the switchgear.

The holder reflector will take a

4 ft, 40 watt tube and this is covered by a front of Perspex. It will operate from normal mains supplies of either 110 V or 250 V alternating current. The lamp is said to be particularly suitable for use in large buildings where it is necessary to light large surfaces such as the sides of buses during painting or repair and where the top lighting is a long way from the ground. *P. W. Allen and Company Limited, 253 Liverpool Road, London, N1.*

CRACK DETECTOR

Up to 20 in Thick Steel

THE Brown Boveri radiographic betatron is now being marketed in this country.

The unit is mainly used for non-destructive testing of materials and for high energy X-ray and electron research. The radiation energy is adjustable up to 31 MeV in one model and up to 35 MeV in others.

Steel can be radiographed up to a thickness of 20 in. At full output with a focus-to-film distance of 2 metres, radiographs of 8 in steel can be obtained in four minutes with a density of two, and in thirty minutes with 12 in thickness of steel.

The instrument has two focal spots each 0·1 mm by 0·3 mm. The wire penetrameter sensitivity over a thickness range of 6 to 14 in of steel is almost constant at 0·3 per cent. At 10 in of steel a wire 0·03 in diameter can still be seen. The very small focus size allows X-ray magnification to be used and thus further improvement in sensitivity can be obtained. The power consumption is

16 kW and a built-in fan supplies the cooling. *Watson and Sons (Electro-Medical) Limited, East Lane, North Wembley, Middlesex.*

BENDING ROLLS

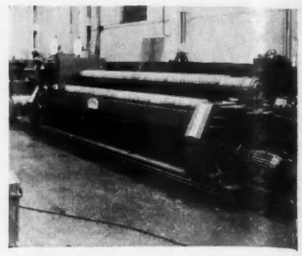
For 14 ft Plate

A SET of bending rolls for plate up to 14 ft wide has been produced recently.

These rolls are of the initial pinch type having four rollers. The capacity is for bending plate up to 14 ft wide by 11 s.w.g. thick into cylinders as small as 13 in inside diameter, or plate 14 ft wide by 10 s.w.g. to 18 in inside diameter.

The bottom pinch roll is adjustable by means of a hand wheel that drives the worm gearing through bevel pinions. The diameter of the top and of the bottom pinch rolls is 11½ in, while the diameter of the side bending rolls is 10 in. The effective working body length of the rolls is 14 ft 2 in.

Power to drive the main rolls is supplied by a 15 h.p. electric motor and there are two motors for adjusting the side rolls, each rated at 10 h.p. An auxiliary drive is provided to the side bending rolls to overcome rolling friction, the drive being taken by means of V-belts and jockey pulleys. The rolling speed is 18 ft per minute.



In order to allow the completed cylinders to be removed from the machine, it is constructed with a pneumatically operated swing down housing. The falling of this housing simultaneously counteracts the dead weight of the top roll. The machine is also equipped with a pneumatically operated push-off for the removal of the completed cylinders. Large indicator dials are provided to show the roll settings. The housings are of all steel fabricated construction and include an oil bath for the worm drives. The rolls are machined from 0·4/5 carbon steel forgings of the highest elongation. *Bronx Engineering Company Limited, Lye, nr Stourbridge.*

TRANSDUCER

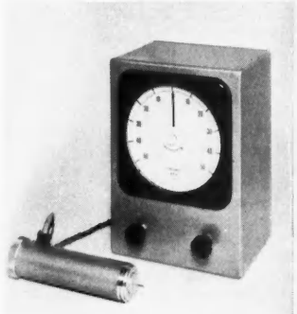
Mains Voltage Operation

THE Lintran transducer is an addition to the Allscott range of electronic instruments.

It uses the principle of the differential transformer which has two windings accurately spaced relative to a central primary winding so that normally the signals from both are equal. If an iron armature is placed within the windings, any movement of the armature results in a difference in signal strength. The design allows this difference in output to be accurately proportional to the movement of the armature. The difference is then displayed on a meter of the type illustrated.

In the Lintran transducer the size of the armature can be varied so that full scale deflection of the meter can be given by movements from 0·001 in to 1 in. This gives a range of transducers to suit widely differing requirements in sensitivity.

One of the chief claims is that the Lintran can be used directly on normal mains supplies without intermediate



circuits and yet it is small in size and accurate in output. The basic unit measures 7¼ in long and 1¾ in diameter. The weight is only 2 lb. The basic unit has the shaft only, but this can be attached to bellows for pressure measuring for example or to other systems where a change can be converted to a movement. *James Scott and Company (Electrical Engineers) Limited, Carntyne Industrial Estate, 68 Brockville Street, Glasgow, E2.*

NEGATIVE VIEWER

Takes Half-Plate Size

THE Barcro "projected" negative viewer has been designed to take negatives up to half-plate size.

The screen measures 22 in wide by 16 in high and when the image size on the film is 5⅞ in by 4 in, the enlargement is to 19 in by 13 in. There is ample room for making notes and additions. The cabinet stands 5 ft high at the front and 4 ft 2 in at the back. The depth from front to back excluding the writing shelf is 1 ft 10 in. The width is 2 ft. The shelf is 9 in wide and is 3 ft 3 in from the floor level.

Illumination is supplied from one lamp rated at 6 V and 48 W, which is supplied from a transformer unit that is fitted inside the cabinet; lamps can be replaced easily. The unit will run from normal mains supplies. It is claimed that the shelf is at the convenient height for the operator who can be seated while using the viewer. The finish is in hammer grey enamel. *E. N Mason and Son Limited, Industri Ph ograp ic Division, Arclight Works Colch ster, Essex*

BRITAIN'S TIMBER INDUSTRY

A short discussion was initiated by Mr. S. Wingfield Digby (Conservative), during one of the last sittings of the House of Commons before the rising for Christmas, on the state of Britain's timber industry. He emphasised the importance of developing and expanding this country's forest-product-using industries and said that Western Germany had produced chipboard, plywood and other types of woodboard to the value of well over £58 million during 1958. It was very desirable that Britain should obtain a larger share of this industry in spite of the increased competition resulting from the Stockholm agreement.

Mr. Digby asked the Minister of State to the Board of Trade to explain the present position respecting the negotiations designed to connect Finland with the European Free Trade Association. He asked Mr. F. J. Erroll to ensure that nothing would be agreed upon which would handicap the progress of the chipboard industry in Britain. Its development was essential as a means of providing an adequate market for the rapidly increasing output of thinnings from British forests.

Continuing difficulty was experienced in disposing of home-grown timber, especially thinnings, arising from work of the Forestry Commission, on which public money was being expended and it was desirable to establish outlets for this timber.

LAMINATED WOOD IN ENGINEERING

Lady Tweedsmuir (Conservative) wanted the Board of Trade to ensure that the sixth set of standards for the use of timber in engineering, now being drafted, should secure fair-competition requirements for British firms producing laminated-timber products, in relation to the products of continental firms. The present standards were being so stringently drawn, compared with continental standards, that it was being made uneconomic for British firms to compete.

In reply, Mr. Erroll said that no figure, comparable to that quoted by Mr. Wingfield Digby for Western Germany, was available in respect of Great Britain's timber products. It was estimated, however, that the quantity of chipboard, plywood and other types of woodboard produced in Western Germany last year amounted to about 760,000 tons and that the corresponding quantity produced in Britain was 140,000 tons. The demand in Britain for all types of woodboard greatly exceeded the existing productive capacity and no action by the President of the Board of Trade appeared to be called for. He thought that the position as it was presented a first-class opportunity for free enterprise in this country.

The Finnish Government was at present considering what proposals it might wish to make for its participation in the EFTA and he was aware of the interest which Britain's chipboard industry would have in any negotiations that might take place. Lady Tweedsmuir had presumably been referring to the work that had been done by the Timber Development Association on recommended standards for structural glued laminated timber. This association was an independent trade body and the Government had no responsibility for their recommendations.

IDEAS ON TRAFFIC CONGESTION

Some interesting suggestions were put forward by Mr. R. Gresham Cooke (Conservative) during a debate on traffic congestion. He felt that London Transport should make another experiment to free traffic in the centre of London. "Great big lumbering" double-decker buses going along in convoys of three, with two of them empty, made their own congestion.

He would like to see London Transport experiment again with single-decker buses with tip-up seats round the sides, so that the whole of the bus could be made available for standing passengers. These buses should be able to carry about 50 people. They could carry a conductor with a ticket office so that people could pay for their tickets as they entered at the rear, as was done abroad, and leave the bus at the front end. Whenever a shopping area was reconstructed, attention should be directed to the possibility of elevating the pavements so as to allow room for vehicles to unload underneath. He was glad to see that provision was made for a piazza at the first-floor level for shops in the new scheme for Piccadilly Circus.

More roads must be squeezed out of redevelopment sites. Parking meters must be extended. He argeed that there should be tougher fines for unauthorised parking. Whereas businessmen did not mind paying £1 or £2, which they could add to their expenses, they would not want to pay as much as £10. In London, the Victoria-Walthamstow tube railway should be built, as part of a long-term solution.

KEEPING MOTORS ON THE MOVE

Various points about traffic congestion in Britain's large towns, and the need for controlling the flow of cars into these areas, were raised by Mr. John Peyton (Conservative) and Mr. Victor Yates (Labour). They asked the Minister of Transport to state what plans he had for improving the position that now existed.

Apart from physical improvements, said Mr. Ernest Marples, he would do everything he could, in cooperation with the local authorities, to see that the street systems in urban areas were used to the best advantage, through the increased application of traffic engineering methods, including the strict control of street parking.

The problem was not so much to control the flow of traffic into town areas as to provide for it by road improvements, and by making the best use of the existing road system. A skilful use of traffic engineering methods would help the Government to bridge the period until the series of road improvements, some of which had already been provided, took on their full shape.

MORE MAIN DRAINAGE SCHEMES

Attention was drawn by Mr. Sydney Irving (Labour-Cooperative) to the numbers of dwellings in England and Wales in which cesspit sanitation and earth-bucket facilities were still in use. He urged upon the Minister of Housing and Local Government that steps should be taken promptly to secure the installation of main sewers in areas not yet provided with modern sanitation.

Sir Keith Joseph, the ministry's Parliamentary Secretary, said that the areas referred to were almost wholly rural localities where main drainage usually had to await the provision of piped-water supplies. Accordingly, the policy of his ministry had been, and still was, to assist local authorities in providing both these services. Since 1951, water-supply schemes costing £55 million and sewerage schemes costing £66 million had been approved. In this connection, Exchequer grants under the Rural Water Supplies and Sewerage Acts, 1944-55, for £38 million, had either already been made or had been promised.

There was no precise information available regarding cesspit and earth-bucket sanitation, but, in 1951, about 8 per cent of households did not have the use of a water closet and about 13 per cent had to share. Since then more than 1,750,000 new dwellings had been built, with the result that the numbers of dwellings without main drainage was being steadily reduced.

Safety Devices for Oil Heaters

Concern was expressed by Dr. Donald Johnson (Conservative) regarding the safety of oil heaters. He asked the Minister of State to the Board of Trade what consultations were taking place between his ministry and the Department of Scientific and Industrial Research with a view to developing safety devices to prevent oil heaters flaring in draughts. Mr. F. J. Erroll said that the development of such safety devices was not a matter for his ministry but he was aware that the DSIR was working on the problem of flaring as a matter of urgency and that a committee of the British Standards Institution was reviewing the standard for domestic stoves. Answering a further point raised by Dr. Johnson, the Minister said that he had no power to direct that these appliances were labelled in such a way as to convey a suitable form of warning to prospective purchasers.

British Railways Points System

Mr. Gilbert Longden (Conservative) wanted the Minister of Transport to give a general direction to the British Transport Commission to improve their points system, in order to avoid collisions such as the one which took place at Neasden on 12 November. Mr. Ernest Marples, however, commented that this matter was not one for the issue of a general direction to the Commission.

Promoting Road Safety

There is to be a major road safety campaign in 1960, designed to bring home to all road users the advice given in the new Highway Code, according to an answer given by Mr. John Hay, one of the two Joint Parliamentary Secretaries to the Ministry of Transport, to Mr. A. E. Hunter (Labour). Mr. Hay said that his Ministry and the Royal Society for the Prevention of Accidents were cooperating in making the necessary arrangements to that end.

Traffic Engineers' Prospects

Better career prospects and more training facilities are the key to increasing the supply of traffic engineers. In this connection, Mr. Ernest Marples, the Minister of Transport, told Mr. Philip Goodhart (Conservative) that he was seeking the cooperation of highway and local authorities in widening the field of employment of these experts. He had been glad to observe that the numbers of post-graduate courses and fellowships at the universities had recently been notably increased and that the professional institutions were offering diplomas in this subject. Action of that kind could well stimulate more courses at the technical colleges.

Helicopters for the Forces

The Minister of Defence was asked by Sir Arthur Harvey (Conservative) about the types of helicopters which have been delivered recently to the Army, Navy and Air Forces. He was told by Mr. Harold Watkinson that, during the past three years, Whirlwinds had been delivered to the Royal Navy, Skeeters to the army, and Sycamores and Whirlwinds to the Royal Air Force. Whirlwinds and Wessex were on order for the navy, Bristol 192's for the RAF, and Skeeters for the army.

Failures of University Students

Suggestions were made by Dr. Alan Thompson (Labour) that the Secretary of State for Scotland should institute an inquiry into the high rate of failure of first-year students at Scottish universities, in view of the findings contained in a survey conducted by Dr. Douglas M. McIntosh, the Director of Education for Fife. Sir Edward Boyle, Bt., the Financial Secretary to the Treasury, replied that inquiries had been conducted from time to time by the University Grants Committee into the success or failure of students at all the universities in Great Britain. He understood that they would shortly be examining the results of their most recent inquiry.

New Factories in Development Areas

Information was sought by Mr. Douglas Jay (Labour) from the Board of Trade about the progress being made with the provision of new Government-financed factory-building schemes. Mr. F. J. Erroll informed him that 96 Government-financed schemes of this kind had been approved so far this year and that no fewer than 207 private schemes had received Industrial Development Certificates up to the end of October. Employment for some 25,000 persons would arise from these schemes.

XUM

Exhibitions and Conferences

This list, in chronological order, appears in the last issue of each month. Events noticed for the first time and alterations of dates, places, etc., are indicated by an asterisk(*). For details of events not included below, reference should be made to ENGINEERING, *30 October, page 403, and 27 November, page 538. Organisers are invited to send particulars of coming events to the Editor.*

Boat Show, Sixth National.—Wed., 30 Dec., 1959, to Sat., 9 Jan., at Earl's Court, London, SW5. Organised by the Ship and Boat Builders' National Federation, 23 Knightsbridge, London, SW1. Tel. BELgravia 6402.

"Model Engineer" Exhibition.—Wed., 30 Dec., 1959, to Sat., 9 Jan., at the Royal Horticultural Society's New Hall, Greycoat Street, London, SW1. Organised by *The Model Engineer* (Percival Marshall and Co., Ltd.), 19-20 Noel Street, London, W1. Tel. GERrard 8811.

***Racing Car Show.**—Sat., 2 Jan., to Sat., 9 Jan., at the Royal Horticultural Society's Old Hall, Vincent Square, London, SW1.

Camping and Outdoor Life Exhibition.—Sat., 2 Jan., to Sat., 9 Jan., at Olympia, London, W14. Organised by New Homes and Trades Exhibitions, Ltd., Exhibition House, Spring Street, London, W2. Tel. AMBassador 5421.

Recent Mechanical Engineering Developments in Automatic Control, Symposium.—Tues., 5 Jan., to Thurs., 7 Jan., at 1 Birdcage Walk, London, SW1. Organised by the Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. Tel. WHItehall 7476.

***Schoolboys' Own Exhibition, National.**—Tues., 5 Jan., to Sat., 9 Jan., at Olympia, London, W14.

Toy Fair, 11th International.—Sat., 9 Jan., to Fri., 15 Jan., at Harrogate. Organised by Harrogate International Toy Fair Ltd., Finsbury Court, Finsbury Pavement, London, EC2. Tel. MONarch 8921.

Electronics, Sixth National Symposium on Reliability and Quality Control in.—Mon., 11 Jan., to Wed., 13 Jan., at the Statler Hilton Hotel, Washington, DC, USA. Information obtainable from Mr. R. Brewer, Research Laboratories, General Electric Co., Ltd., Wembley, Middlesex. Tel. Arnold 1262.

***"War on Want," International Exhibition.**—Sat., 16 Jan., to Sat., 23 Jan., at the Central Hall, Westminster, London, SW1.

***Motor, Motor Cycle and Cycle Exhibition, Brussels International.**—Sat., 16 Jan., to Wed., 27 Jan., in Brussels. Organised by the Salon de l'Automobile et du Cycle, 22 Rue du Luxembourg, Brussels 4, Belgium.

PHYSICAL SOCIETY

Physical Society's Exhibition of Scientific Instruments and Apparatus.—Mon., 18 Jan., to Fri., 22 Jan., at the Royal Horticultural Society's Old and New Halls, Vincent Square and Greycoat Street, London, SW1. Organised by the Physical Society, 1 Lowther Gardens, Prince Consort Road, London, SW7. Tel. KENsington 0048.

Hotel and Catering Exhibition, International.—Tues., 19 Jan., to Thurs., 28 Jan., at Olympia, London, W14. Organised by the Hotel and Catering Exhibition (London) Ltd., 623 Grand Buildings, Trafalgar Square, London, WC2. Tel. WHItehall 1371.

***Furniture Exhibition, 11th.**—Mon., 25 Jan., to Sat., 6 Feb., at Earl's Court, London, SW5. Organised by F. W. Bridges and Sons, Ltd., 641 Grand Buildings, Trafalgar Square, London, WC2. Tel. WHItehall 0568.

Pilot Plants in Metallurgical Research and Developments, Symposium.—Early February, at Jamshedpur, India. Organised by the National Metallurgical Laboratory, Jamshedpur 7, India.

Cleaning and Maintenance and Floor Trades Exhibition and Convention, First.—Mon., 1 Feb., to Fri., 5 Feb., at Royal Horticultural Society's Old Hall, Vincent Square, London, SW1. Organised by Contemporary Exhibitions, Ltd. 40 Gerrard Street, London, W1. Tel. GERrard 4951.

***Gifts and Fancy Goods Fair, 11th International.**—Mon., 1 Feb., to Fri., 5 Feb., at Blackpool. Organised by the Fancy Goods Association, St. Dunstan's House, Carey Lane, London, EC2. Tel. MONarch 0871.

Amusement Trades Exhibition, 16th.—Tues., 2 Feb., to Thurs., 4 Feb., at the Royal Horticultural Society's New Hall, Greycoat Street, London, SW1. Organised by Amusement Trades Exhibition Ltd., 19 Charing Cross Road, London, WC2. Tel. WHItehall 2524.

***"This is the Commonwealth" Exhibition.**—Thurs., 4 Feb., to Sat., 20 Feb., at Bingley Hall, Birmingham.

***Nylon Fair, Fifth National.**—Mon., 8 Feb., to Fri., 12 Feb., at the Royal Albert Hall, Kensington Gore, London, SW7. Organised by Trade Fairs and Promotions Ltd., Drury House, Russell Street, London, WC2. Tel. TEMple Bar 3422.

Stationery Trades Exhibition, Sixth.—Mon., 8 Feb., to Fri., 12 Feb., at Alexandra Palace, London, N22. Organised by the Stationers' Association of Great Britain Ltd., 6 Wimpole Street, London, W1. Tel. LANgham 9256.

Agricultural Machinery and Equipment Exhibition.—Sun., 14 Feb., to Sun., 21 Feb., at Brussels. Organised by the Société de Mécanique et d'Industrie Agricole, 29 Rue de Spa, Brussels 4.

Industrial and Commercial Refrigeration Exhibition, First.—Mon., 15 Feb., to Wed., 17 Feb., at the Old Hall of the Royal Horticultural Society, Vincent Square, London, SW1. Sponsored by *World Refrigeration*. Organiser: Mr. Patrick Smyth, 1 Crane Court, Fleet Street, London, EC4.

Automatic Vending Exhibition and Convention, Second International.—Mon., 15 Feb., to Thurs., 18 Feb., at the Royal Horticultural Society's New Hall, Greycoat Street, London, SW1. Organised by Contemporary Exhibitions Ltd., 40 Gerrard Street, London, W1. Tel. GERrard 4951.

British Toy Fair.—Mon., 15 Feb., to Fri., 19 Feb., at Brighton. Organised by the British Toy Manufacturers' Association, 93-94 Hatton Garden, London, EC1. Tel. CHAncery 9158.

LEATHER GOODS

***Leather Goods Industries Fair, Eighth Annual.**—Mon., 15 Feb., to Fri., 19 Feb., at Mount Royal Hotel, Marble Arch, London, W1. Organised by *Leathergoods*, 15 Cursitor Street, London, EC4. Tel. CHAncery 4001.

Scottish Dairy Show.—Tues., 16 Feb., to Fri., 19 Feb., at the Kelvin Hall, Glasgow. Organised by the Glasgow Agricultural Society, 51 Moss Street, Paisley, Renfrewshire.

***Motor Show, Amsterdam International.**—Thurs., 18 Feb., to Sun., 28 Feb., at Amsterdam. Apply to the RAI secretariat, 13 de Lairessestraat, Amsterdam.

Display Market Week, Third.—Mon., 22 Feb., to Thurs., 25 Feb., at the Russell Hotel, Russell Square, London, WC1. Organised by the National Display Equipment Association, 2 Caxton Street, London, SW1. Tel. ABBey 4813.

***Carpet, Linoleum and Floor Coverings Trade Fair, Fourth.**—Mon., 22 Feb., to Fri., 26 Feb., at Earl's Court, London, SW5. Organised by Trade Fairs and Promotions Ltd., Drury House, Russell Street, London, WC2. Tel. TEMple Bar 3422.

***Household Textiles and Soft Furnishings Trade Fair, Seventh.**—Mon., 22 Feb., to Fri., 26 Feb., at the Royal Albert Hall, Kensington Gore, London, SW7. Organised by Trade Fairs and Promotions Ltd., Drury House, Russell Street, London, WC2. Tel. TEMple Bar 3422.

Engineering Materials and Design Exhibition and Conference, First.—Mon., 22 Feb., to Fri., 26 Feb., at Earl's Court, London, SW5. Organised by Industrial and Trade Fairs Ltd., Drury House, Russell Street, London, WC2. Tel. TEMple Bar 3422.

Scientific Management, 12th International Congress of the International Committee of (COS).—Mon., 22 Feb., to Fri., 4 Mar., in Sydney and Melbourne, Australia. Organised by the Australian Institute of Management. Inquiries in the United Kingdom should be addressed to the Regional and Overseas Department, British Institute of Management, 80 Fetter Lane, London, EC4. Tel. HOLborn 3456.

***Motor Exhibition, Copenhagen International.**—Fri., 26 Feb., to Sun., 6 Mar., in Copenhagen. Organised by the Danish Association of Automobile Manufacturers and Importers, 22 Amaliegade, Copenhagen K, Denmark.

HOSIERY AND KNITWEAR

***British Hosiery and Knitwear Exhibition, Third.**—Mon., 29 Feb., to Fri., 4 Mar., at the Royal Horticultural Society's New Hall, Greycoat Street, London, SW1. Organised by Industrial Exhibitions (Services) Ltd., 9 Argyll Street, London, W1. Tel. GERrard 1622.

***Smallwares Trade Fair, Seventh.**—Mon., 29 Feb., to Fri., 4 Mar., at the Queen's Hotel, Hastings. Organised by Trade and Technical Exhibitions, 1 Dorset Buildings, Salisbury Square, London, EC4. Tel. FLEet Street 1555.

***Toy Fair, Nuremberg International.**—Thurs., 3 Mar., to Tues., 8 Mar., in Nuremberg. Agent: Mr. Neven du Mont, 123 Pall Mall, London, SW1. Tel. WHItehall 8211.

***Motor Show, Geneva International.**—Thurs., 10 Mar., to Sun., 20 Mar., in Geneva. Organised by the Fondation du Salon de l'Automobile, 1 Place du Lac, Geneva, Switzerland.

***Stationery and Allied Trades Fair, Sixth National.**—Mon., 28 Mar., to Fri., 1 April, at the Royal Horticultural Society's Old and New Halls, Vincent Square and Greycoat Street, London, SW1. Organised by the *National Newsagent, Bookseller, Stationer*, 149 Fleet Street, London, EC4. Tel. CITy 2604.

***Fuel Efficiency and Power for Industry Exhibition.**—Wed., 27 April, to Fri., 6 May, at Olympia, London, W14. Organised by Provincial Exhibitions Ltd., City Hall, Deansgate, Manchester 3. Tel. Deansgate 6363.

***Graz International Spring Fair.**—Sat., 30 April, to Sun., 8 May, at Graz, Austria. Apply to the British Austrian Chamber of Commerce, 29 Dorset Square, London, NW1. Tel. PADdington 7646.

***Brussels International Industries Fair, 33rd.**—Sat., 30 April, to Wed., 11 May, at Brussels. Apply to Belgian Railways, 167 Regent Street, London, W1. Tel. REGent 1491.

***Zagreb International Spring Fair.**—Sat., 30 April, to Sun., 15 May, at Zagreb. Agents: Auger and Turner Group Ltd., 37-38 Margaret Street, Cavendish Square, London, W1. Tel. HYDe Park 7282.

***Valencia Samples Fair, 38th International.**—Sun., 1 May, to Sun., 15 May, at Valencia. Organised by the Feria Muestrario Internacional de Valencia, 2 Llano del Real, Valencia.

***Dublin Spring Show and Industries Fair.**—Tues., 3 May, to Sat., 7 May, in Dublin. Organised by the Royal Dublin Society, Ball's Bridge, Dublin.

Grocers' and Allied Trades Exhibition.—Tues., 3 May, to Sat., 14 May, at Belle Vue, Manchester. Offices: 393 Corn Exchange, Manchester 4. Tel. Blackfriars 4969.

Hardware Trades Fair, International.—Mon., 9 May, to Fri., 13 May, at Olympia, London, W14. Organised by Universal Exhibitions Ltd., 74 Holland Park, London, W11. Tel. PARk 7360.

Kemp's Television Production Exhibition.—Mon., 9 May, to Fri., 13 May, at Alexandra Palace, Wood Green, London, N22. Apply to the general manager, Kemp's Commercial Guides Ltd., 299-301 Gray's Inn Road, London, WC1. Tel. TERminus 0152.

***Paris Trade Fair, 50th International.**—Sat., 14 May, to Sun., 29 May, in Paris. Apply to the French Chamber of Commerce, 74 Brook Street, London, W1. Tel. HYDe Park 2744.

SWISS IMPORTS

***Swiss Import Exhibition (ZUSPA) (Technical Goods).**—Fri., 20 May, to Sun., 29 May, at Zürich. Exhibition offices: 20 Nordstrasse, Zürich 6, Switzerland.

***Budapest Industrial Fair.**—Fri., 20 May, to Mon., 30 May, in Budapest. Apply to the Hungarian Chamber of Commerce, 17 Rosenberg h.p.u., Budapest V, Hungary.

***Medical Exhibition.**—Mon., 23 May, to Fri., 27 May, at St. Andrew's Hall, Glasgow. Organised by B and CD Trades Exhibitions Ltd., 194-200 Bishopsgate, London, EC2. Tel. AVEnue 1444.

Self-Service and Shop Equipment Exhibition.—Mon., 23 May, to Fri., 27 May, at Olympia, London, W14. Organised by Universal Exhibitions, Ltd., 74 Holland Park, London, W11. Tel. PARk 7360.

Royal Ulster Agricultural Show, 93rd.—Wed., 25 May, to Sat., 30 May, at the King's Hall, Belfast. Organised by the Royal Ulster Agricultural Society, King's Hall, Balmoral, Belfast.

***British Electrical Power Convention.**—Mon., 30 May, to Thurs., 2 June, at Bournemouth. Offices of the Convention: Eastcastle Street, London, W1. Tel. MUSeum 4040.

Bath and West Agricultural Show.—Wed., 1 June, to Sat., 4 June, at the Show Site, Bath. Organised by the Bath and West and Southern Counties Agricultural Society, 3 Pirrepoint Street, Bath. Tel. Bath 3010.

***World Power Conference, Sectional Meeting.**—Sun., 5 June, to Thurs., 9 June, at Madrid. Apply to the secretary, British National Committee, World Power Conference, 201-202 Grand Buildings, Trafalgar Square, London, WC2. Tel. WHItehall 3966. *Note:* The Sixth Plenary Meeting of the Conference will take place in Australia in 1962; and there will be a Sectional Meeting in Switzerland in 1964.

***Three Counties Agricultural Show.**—Tues., 14 June, to Thurs., 16 June, at the Show Site, Malvern. Organised by the Three Counties Agricultural Society, Malvern, Worcs. Tel. Malvern 2231.

***Nuclear and Electronic Congress and Exhibition, Seventh.**—Wed., 15 June, to Wed., 29 June, in Rome. Agents: Auger and Turner Group Ltd., 37-38 Margaret Street, Cavendish Square, London, W1. Tel. HYDe Park 7282.

***Institution of Mechanical Engineers Summer Meeting.**—Mon., 20 June, to Thurs., 23 June, in Northern Ireland. Organised by the Institution of Mechanical Engineers, 1 Birdcage Walk, St. James' Park, SW1. Tel. WHItehall 7476.

***Malta Trade Fair, Fourth.**—Thurs., 30 June, to Sun., 10 July, at Valletta. Organised by the Malta Trade Fair Corporation, Exchange Buildings, Valletta.

***Royal Agricultural Society Show.**—Tues., 5 July, to Fri., 8 July, at Cambridge. Organised by the Royal Agricultural Society of England, 35 Belgrave Square, London, SW1. Tel. BELgravia 5323.

***Great Yorkshire Agricultural Show.**—Tues., 12 July, to Thurs., 14 July, at the Show Ground, Harrogate. Organised by the Yorkshire Agricultural Society, Cliftonfield, Shipton Road, York. Tel. York 23102.

Sydney Engineering Exhibition.—Mon., 18 July, to Sat., 23 July, at the Showground, Sydney. Apply to Industrial Public Relations Service (NSW), Pty., Ltd., Box 4962, GPO, Sydney, New South Wales.

***Royal Welsh Agricultural Society Show.**—Wed., 20 July, to Fri., 22 July, at Welshpool. Apply to the Royal Welsh Agricultural Society, Queens Road, Aberystwyth. Tel. Aberystwyth 7551.

***British Association Meeting.**—Wed., 31 Aug., to Wed., 7 Sept., at Cardiff. Apply to the secretary, British Association for the Advancement of Science, 18 Adam Street, Adelphi, London, WC2. Tel. TRAfalgar 5733.

British Food Fair, Sixth.—Thurs., 1 Sept., to Sat., 17 Sept., at Olympia, London, W14. Organised by the Food Manufacturers Federation, Inc., 10 Mount Row, London, W1. Tel. HYDe Park 2933.

FARNBOROUGH DISPLAY

***Farnborough Flying Display and Exhibition.**—Mon., 5 Sept., to Sun., 11 Sept., at Farnborough, Hampshire. Open to the public on Fri., Sat. and Sun., 9, 10 and 11 Sept., only. Organised by the Society of British Aircraft Constructors, 29 King Street, London, SW1. Tel. TRAfalgar 3231.

Operational Research, Second International Conference on.—Mon., 5 Sept., to Fri., 16 Sept., in Aix-en-Provence, France. Organised by the International Federation of Operational Research Societies (IFORS), 11 Park Lane, London, W1.

Photogrammetry, Ninth International Congress on.—Mon., 5 Sept., to Sat., 17 Sept., in London, under auspices of the International Society for Photogrammetry. Congress director: Colonel J. B. P. Angwin, 18 Cavendish Square, London, W1. Tel. LANgham 1626.

***Factory Equipment, Heating, Ventilation and Thermal Insulation Exhibition, Eighth.**—Wed., 21 Sept., to Sat., 1 Oct., at Belle Vue, Manchester. Organised by Industrial and Trade Fairs Ltd., Drury House, Russell Street, London, WC2. Tel. TEMple Bar 3422.

***Commercial Motor Transport Exhibition, International.**—Fri., 23 Sept., to Sat., 1 Oct., at Earl's Court, London, SW5. Organised by the Society of Motor Manufacturers and Traders Ltd., Forbes House, Halkin Street, London, SW1. Tel. BELgravia 6611.

***Royal Horticultural Society's Great Autumn Show.**—Tues., 27 Sept., to Thurs., 29 Sept., at the Royal Horticultural Society's Old and New Halls, Vincent Square and Greycoat Street, London, SW1. Offices of the Society: Vincent Square, London, SW1. Tel. VICtoria 4333.

Brewers' Exhibition.—Mon., 3 Oct., to Fri., 7 Oct., at Olympia, London, W14. Organised by Trades Markets and Exhibitions, Ltd., 623 Grand Buildings, Trafalgar Square, London, WC2. Tel. WHItehall 1371.

Business Efficiency Exhibition, 47th.—Mon., 3 Oct., to Wed., 12 Oct., at Olympia, London, W14. Organised by Office Appliance and Business Equipment Trades Association of Great Britain and Ireland, 64 Cannon Street, London, EC4. Tel. CENtral 7771.

PARIS MOTOR SHOW

***Motor and Motor Cycle Show, Paris International.**—Thurs., 6 Oct., to Sun., 16 Oct., in Paris. Agent: Mr. R. C. Liebman, 178 Fleet Street, London, EC4. Tel. CITy 5889.

Building Trades Exhibition, 23rd.—Tues., 11 Oct., to Sat., 22 Oct., at City Hall Deansgate, Manchester. Organised by Provincial Exhibitions Ltd., City Hall, Deansgate, Manchester 3. Tel. Deansgate 6363.

***Technology of Plastics Processing, International Congress on.**—Mon., 17 Oct., to Wed., 19 Oct., in Utrecht. Followed by the **Second International Plastics Exhibition ("macro Plastic").**—Wed., 19 Oct. to Wed., 26 Oct., at the exhibition halls, Utrecht, Netherlands. Organised by N.V.'t Raedthuys Tesselschadestraat 5, Amsterdam, Netherlands. (Alterations to dates.)

***Motor Show (45th International Motor Exhibition).**—Wed., 19 Oct., to Sat., 29 Oct., at Earl's Court, London, SW5. Organised by the Society of Motor Manufacturers and Traders Ltd., Forbes House, Halkin Street, London, SW1. Tel. BELgravia 6611.

***Dairy Show, 74th Annual.**—Tues., 25 Oct., to Fri., 28 Oct., at Olympia, London, W14. Organised by the British Dairy Farmers' Association, 17 Devonshire Street, London, W1. Tel. LANgham 6903.

Cycle and Motor Cycle Show, 33rd.—Sat., 12 Nov., to Sat., 19 Nov., at Earl's Court, London, SW5. Organised by British Cycle and Motor Cycle Industries Ltd., Eaton Road, Coventry. Tel. COVentry 62511.

***Industrial Photographic and Television Exhibition and Conference, Second.**—Mon., 21 Nov., to Fri., 25 Nov., at the Royal Albert Hall, Kensington Gore, London, SW7. Organised by the Industrial and Trade Fairs Ltd., Drury House, Russell Street, London, WC2. Tel. TEMple Bar 3422.

Corrosion Exhibition.—Tues., 29 Nov., to Fri., 2 Dec., at Olympia, London, W14. Organised by *Corrosion Technology*, Leonard Hill House, Eden Street, London, NW1. Tel. EUSton 5911.

TUC into battle

The Trades Union Congress has long striven for a comprehensive industrial health service, holding that, quite apart from the hours a man works, the health problems of factories and plant in general call for a properly designed service.

Only in three areas are small pilot schemes operating and providing, first a service, but second the pilot evidence on which the case for an industrial health service can be argued more certainly.

Now the Ministry of Health has decided that its assistance to an industrial health service run for factories in the Acton and Willesden area, in association with the Central Middlesex Hospital, must be seriously reduced. The unit was set up three years ago with an initial grant from the Nuffield Foundation but it is not yet self-supporting, although 30 firms, none large enough to keep a doctor busy themselves, are at present paying sixpence a week each for some 4,000 employees.

The scheme is seen to be in danger of collapsing from lack of the money to continue and the TUC has asked the Minister of Health for assurances that the work of this unit, in its way a pioneer, shall not be broken off.

Change in Syllabus

The 1960 examinations (24, 25 and 26 May) of the Association of Supervising Electrical Engineers are likely to be the last that will be held on the present syllabus and regulations, which have been in use since 1946 with some modifications.

Developments in the rest of the educational world and changing industrial conditions have made it necessary for the association to undertake a full review of its syllabus and this is now being done. The association is at pains to stress that the basic object of the ASEE diploma scheme is not being altered. This, says ASEE, is to encourage and give recognition to those who seek to go forward in the electrical industry and who can bring evidence of practical and technical ability and of judgment and competence.

It is intended that from 1961 those who hold the City and Guilds of London Institute's full technological certificate and who have industrial experience and the approved training shall be able through the ASEE diploma scheme to hold quotable evidence of supervisory and administrative abilities.

Engines and Engineers

Marine engineers went to sea because their engines went there. Men took to ships from the middle of last century to look after the new steam engines; their qualifications were mixed and they were maintenance men afloat rather than either qualified engineers or seamen. The captain of the ship gave up his direct control of his boilers only slowly and often reluctantly. The ship's engineer improved his status only slowly as technical change in marine propulsion became more complicated and science and engineering evolved new and better types of ship.

The story of the struggle for recognition for the ship's engineer and for the engineer ashore (be he supervisor or office man evolving new engine designs) has been told recently in a paper given before the Society of Naval Architects and Marine Engineers in New York by Mr. C. C. Pounder, director and chief technical engineer of Harland and Wolff Limited. He has followed the evolution of the marine engineer in terms of both the technical changes in ships and in the improving training, qualifications and education (in the full sense of that word) of the men who have designed them. Mr. Pounder's own career indicates the degree of success which the marine engineer can achieve in reaching board level. How the status of the profession has developed through several generations of technical change and human prejudice can be followed in this paper called "Human Problems in Marine Engineering." "The engineer of 1959 bears no more relation to his predecessor of 1859," says Mr. Pounder, "than the latest steam turbine installation does to the primitive steam reciprocator and haystack boiler of a hundred years ago."

The Cost of Accidents

For every reportable accident there may be 50 or 100 minor ones. This means that there may be a million such accidents every year in the building industry alone. The implications of such a possibility in terms of the cost of accidents and accident prevention were discussed recently in a talk called "The Cost of Safety and the Cost of Accidents" given by Mr. G. H. Stuart Price to the London Building and Engineering Contractors Accident Prevention Group.

Mr. Price said most people tend to overestimate the cost of accident prevention and to under-estimate the cost of accidents themselves. A true cost of a minor accident possibly worked out at around £10. There was not only the temporary loss of time to the person injured but also the dislocation caused by inquiries, delays to production caused by other people stopping work either to help or to see what had happened.

He thought that the only way to reduce cost was by having good supervision (which involved site tidiness), adequate safety equipment and training. His own firm had found the cost of specific training in accident prevention to be entirely justified.

Aid for Professional People

Last year the Professional Classes Aid Council (the annual report covers the 12 months to end March, 1959) handled more cases and gave more assistance than ever before. Out of 814 applications received 377 were given help and over £13,000 was disbursed directly as well as over £3,000 on behalf of other charities. It is a feature of the times that an organisation of this kind continues to expand its work on worthwhile cases.

The Council has on it representatives from a number of professional organisations including seven engineering institutions which include the Civils, Mechanicals and Electricals. In the latest report it could record a satisfactory financial position but the need for funds (the Council is appealing particularly for seven year deed of covenant schemes) is still urgent.

A feature of last year's aid was the drop in assistance given for educational purposes and an increase in general help notably to the older affiliates of the professions. The growing numbers of old people and the difficulty for some professional men and women to make adequate provision for later years especially if they become incapacitated and therefore unable to work, never mind to retire, seems likely to increase the call on the Council's resources.

Surtax Status

There is an even chance of industry's younger managers climbing into the surtax class during their careers. At present some 15 per cent of executives in their 30's are already in that class. The proportion rises with age, to 27 per cent, 40 per cent and 50 per cent respectively for those in their 40's, 50's and those of 60 and over.

This picture of managers' earnings emerges from a survey of 700 executives conducted by the magazine *Business*. Another, perhaps less comforting, finding is that some executives do not keep climbing: many "fall off the ladder and have to start again" in their late 40's or early 50's. One of the main factors in this is a change in the fortunes of their firms.

After Bowling—Trokarting

The American game of bowls recently started to sweep this country. It is being followed by trokarting or karting for short (no apostrophe needed apparently). This sport is being sponsored in this country by Trojan Limited who recently demonstrated the trokart to an enthusiastic audience of RAF pilots at Biggin Hill.

Trokarts are small tubular frames, maximum length 6 ft and wheelbase 4 ft 2 in, four wheels diameter 9 in to 12½ in, no bodywork above the centre line and with one or two 100 c.c. two-stroke engines directly driving without gearbox or differential, either one or both of the rear wheels.

The appeal of this sport is the small track needed (an important consideration in these days of high land values) and the exhilaration of running round a track four inches from the ground at 30 to 40 m.p.h. The illusion of high speed is thus created without its attendant dangers to life and limb. It may catch on quickly if it can acquire a serious clientele and not become associated in the mind mainly with dodg'ems and small boys' bogie cars.

Highway Engineering Scholarship

A second annual post-graduate scholarship has been awarded to the School of Highway Engineering at Birmingham University by Aveling-Barford Limited. Winner of the post is Mr. G. M. Andavan, assistant engineer at the Highways Research Station in Madras, who specialised in highways engineering at Madras University.

The £300 scholarship entitles the recipient to attend a twelve months post-graduate course in highway and foundation engineering at the university leading to the degree of Master of Science in highway engineering. The scholarship was introduced last year to encourage engineers all over the world to take advantage of facilities in this country for increasing world awareness of the British contribution to highway engineering knowledge. Following from this, of course, is the scope for promoting the interests of British construction and contractors' plant industries.

Candidates for this scholarship can be of any nationality. The qualifications are academic, not racial. The sponsoring company would like to draw scholars from as large a number of countries as possible over a period of time.

Training on HP

The news that the cost of hire purchase to the consumer is likely to be reduced, as a result of competition, is paralleled by announcements of new facilities the companies are eager to provide. One of the latest relates to the finance of training costs for those who wish to become air pilots.

The Association of British Aero Clubs and Centres have made an arrangement with United Dominions Trust, one of the largest hire purchase companies, for deferred payment facilities to be made available for flying training at ABAC member clubs which offer Ministry of Aviation approved courses for the private pilot's licence. The facilities will also extend to refresher and advanced courses up to a maximum cost of £200 with payments spread over a period of 18 months.

The example of ABAC may well be followed by other educational and training organisations. Provided the hire purchase companies quote reasonable terms, it could be a boon to the young men and women who want to master a skill or to improve upon their knowledge but cannot afford to do so over the relatively short period of a special course.

Decline and Fall

As the great Gamow once observed, somewhat redundantly: "The tide is just like an elevator, it goes up and down." The statement sums up admirably the experiences of British engineering firms that were swept away by the tidal current of nuclear development. So far the score is one "up" and one "down." ENGINEERING now traces the fortunes of one particular firm which got—unwittingly, it seems—involved in nuclear development.

November 1952

From the chairman's address of Sir Persivale Swampside to the shareholders of Newer Mouldings Limited: "Greatness in engineering is a consequence of advanced thinking, and I think I may submit to you without fear of contradiction, that our company has always been characterised by greatness. If I may digress for a minute and recall the most prosperous years of our company's history, the years between 1938 and 1939, those were the very years when advanced thinking characterised our operations. In those years we were the only industry in Britain to have the foresight to concentrate on mechanised warfare, counter to the prevailing mood of disarmament. In 1937 we added a complete mechanised army to our line, and doubled the productive capacity of our tin soldier department. Greatness and foresight are traditional with us, Ladies and Gentlemen, and we intend to maintain that tradition even in view of the post-war slump in tin soldier sales. We are searching for new fields where our technical capabilities can be applied."

January 1953

Announcement in the daily press: "At a press conference at Injector House, Sir Persivale Swampside announced last night that the name of Newer Mouldings Limited has been changed to Nuclear Injections Limited. When questioned about the significance of the change, Sir Persivale declined to comment. At the stock exchange it is speculated that the manufacture of toy atomic bombs is planned and shares of Nuclear Injections have dropped catastrophically."

August 1953

Press release from Injector House: "Nuclear Injections help build Britain's nuclear future! Large contract for Harwell extension. In the face of stiff competition, the designing skill of Nuclear Injection's engineers has secured a large contract for the supply of plastic coat hangers to the new extension of the Harwell laboratories. Work at Harwell may lead to developments that will revolutionise the generation of power in Britain and the world."

February 1955

The Government White Paper *A Programme of Nuclear Power* announces construction of 12 nuclear power stations to generate 1,500 to 2,000 MW(e) by the end of 1965. Capital cost of the programme is estimated at £300 million. Britain has taken over world leadership in the peaceful application of nuclear energy.

January 1956

Formation of a new consortium, the Gigantic Reactor Company (GRC) is announced from Injector House. The consortium will include firms capable of executing all phases of nuclear power station design and construction from "coat hangers to control rods," said Sir Persivale.

November 1956

Quotation from ENGINEERING: "The inadequacy of coal stocks and current insecurity of oil supplies underlines the importance of enlarging the atomic power programme even if this means some austerity in other fields. Sir —— —— has suggested that in view of the fuel situation the number of stations planned should not be 12 but 112!"

Entry in Sir Persivale's private diary: Lost Hunterston, lost Berkeley, lost Bradwell; onwards to Hinkley Point, we shall continue to tender!

January 1957

Quotation from ENGINEERING: "The conclusion is inescapable: nuclear engineering must continue to grow, and at a faster rate. The strength of the demand for its products at home will give it considerable competitive strength abroad. The export future of the industry is probably brighter than that of any other section of engineering."

February 1957

Quotation from ENGINEERING: "Sir —— —— forecast that beyond 1965 there would be a chain of giant atomic power stations stretching across Western Europe and feeding the bulk of the Continent's electricity needs into a super high-voltage grid.

March 1957

Announcement in the daily press: "The Government has announced a revised programme of nuclear power, under which nuclear energy would be providing 5,000 to 6,000 MW of electricity by 1965 instead of 1,500 to 2,000 MW as originally planned. Lord —— Minister of Power, made the point that in spite of the increased output, it will still be possible to consider all overseas inquiries for the export of nuclear power stations."

June 1957

Entry in Sir Persivale's private diary: "Lost Hinkley Point. The future of atomic energy is abroad. We shall export. Germany, France, Sweden, Italy, Japan, clamouring for power." Entry two days later: "Lost Tokai Mura."

November 1957

Entry in Sir Persivale's private diary: "Lost Latina." Extracts from a speech by Sir Persivale Swampside to the annual meeting of the shareholders: "Our experience with the lack of interest shown in the export markets for our brand of nuclear power reactor indicates that we have miscalculated our export programme. It is becoming clear that underdeveloped countries can neither afford our stations nor have the installed capacity to absorb blocks of power in the sizes offered by us. Industrial countries on the other hand are rapidly catching up with the engineering of reactors and are anxious to develop their own nuclear industry. It may be concluded that the lucrative market for nuclear reactors lies in underdeveloped countries, and that a suitable small reactor must be developed for their use. Your company, with traditional foresight, has been pioneering a 'small reactor' which we are now ready to offer for export. I am sorry to report, however, that our negotiations with Brazil, India, Cuba, and Thailand have not borne fruit, and our negotiations with Monaco, San Marino and Andorra are not progressing as expected." From private diary: "The Vatican deal fell through. Hard luck."

February 1958

Quotation from ENGINEERING: "The possibility that the days of the fission reactor may be numbered is one that must be giving many cause for thought and one that certainly needs airing; but it is a matter of such gravity that superficial speculation may well be hazardous. Sir —— ——— has stated categorically that official thinking on fission reactors has not been altered by the successful thermonuclear experiments. Success in thermonuclear development may not exclude the fission reactor: fission and fusion may be complementary."

March 1958

Quotation from ENGINEERING: "Cracks in the fabric of nuclear development are already beginning to show. Unexpected developments have included the apparently unforeseen current glut of coal, and the vast increase in stocks of uranium. The United Kingdom power programme has been cut by 10 per cent, and exports have been mainly restricted to technical know-how. For these reasons it might be difficult to recover the very considerable sums that had been expended by the atomic power groups on research and development."

May 1958

From the appointments section: "Gigantic Reactor Company, Research and Development Department. Applications are invited from physicists and engineers with several years of experience in plasma physics, magnetohydrodynamics, and high temperature materials for new department. The responsibilities and scope of the project require the highest skill and initiative. Pension plan, rapid advancement in growing company, and liberal holidays."

November 1958

Address of Sir Persivale Swampside to the annual meeting of shareholders: "We can look back on our progress during the last three years with some satisfaction. Although we have not yet secured a major contract for nuclear power stations, we are still in the forefront of development. Results from our fusion department are so far eminently satisfactory, and although the foresighted decision to start design studies of a 'small reactor' has not resulted in an export contract, we are now in an excellent position to take advantage of the unparalleled opportunities in nuclear ship propulsion. Britain is the leading maritime nation of the world and also the leader in the application of nuclear power. We are looking forward with confidence to early construction of a nuclear powered vessel."

June 1959

Entry in Sir Persivale's diary: "Lost Trawsfynydd. Are there any left?"

August 1959

From the daily press: "What is Wrong with Zeta? It had been confidently expected that Zeta II would achieve true thermonuclear power. This hope has now had to be abandoned. When Zeta I was modified in 1958 to increase the discharge by 50 per cent, the number of neutrons observed fell instead of increasing. Practical thermonuclear power is now as remote as it appeared five years ago."

November 1959

From the daily press: "The nuclear powered merchant ship is still 'wildly uncommercial,' said Sir ——— ———, president of the International Shipping Federation. It is now considered unlikely that either the Galbraith Committee, or commercial shipping interests will come to an early decision in favour of constructing a nuclear surface vessel."

December 1959

From the chairman's address of Sir Persivale: "The decision to leave the nuclear power consortium of GRC is in keeping with the farsighted policy of this firm that has characterised our operations from the very beginning. Our association with nuclear engineering, although not financially profitable, has resulted in great scientific benefits to our research and development department who are now at the forefront of new development. Their knowledge has now been applied to a new commercial product that, I am very pleased to say, has received immediate and wide acceptance both at home and on the export market into industrialised countries, and the day when even underdeveloped countries with cold climates will be bidding for our product is not far away. Such success would not have been possible without our deep involvement in nuclear engineering; it is the result of scientific experience recently gained. Advance sales of our new product, the Arctice (Advanced Refractory Toiletseat for Cold Climates), with its embedded electrical or steam heating coils, have surpassed the wildest expectations and we are now looking forward, I can assure you, to a most prosperous year of operation.

December 1965

The Gigantic Reactor Company have finally decided to enter the fast expanding mini-reactor field. Their 2 MW(e) machine Baby-Wham was unveiled last week, and ENGINEERING was given an exclusive opportunity to test-operate this newest and most exciting addition to the GRC stable of power reactors. The Baby-Wham is a low-cost reactor which nevertheless incorporates many luxury features found only on models costing several times as much.

Slipping into the opulently upholstered control seat (and getting in and out is astonishingly easy for a reactor this size) the first thing one notices is the simplicity and attractive design of the control layout. Only two dials—doubling-time and power-level—are used, the rest is accomplished with a few simple warning lights. On the left, within easy reach, is the four-speed synchromesh control-rod lever. This proved to be somewhat stiff, but we found that the Baby-Wham, with only 6 MWD on the clock, had not yet been broken in. To the right is the trusty scram-button painted brilliant red and designed to trip under a 6 oz force. The Baby-Wham was certainly designed to reduce fatigue!

After a brief familiarisation with the layout, we took the little machine on a couple of power excursions around 5 MW. Power rise was a little sluggish at first but we soon got used to the four-speed control and later results proved that the Baby-Wham—given half a chance—could keep up with anything on the national power grid. Altogether, we feel that this little package of power, with the backing of GRC's many years of outstanding experience, will be a hot contender in the field.

Optional extras include the well-known Fluidshuff automatic fuelling machine; a tea-warmer for the console in three choices of colour; and the revolutionary Inertial Scram System (ISS). The latter is an attachment to the underside of the revolving seat incorporating a flyball arrangement. Sudden rotation of the seat—a probable occurrence under scram conditions—causes the balls to fly outward and automatically trip the safety circuit. Equipped with ISS, even a novice can operate this reactor with impunity.

Notes and News

Euratom Links

The web of agreements which Euratom has been weaving with member countries is gradually taking shape. With Britain, a meeting between Euratom and Government officials will probably lead to some agreement on thermonuclear research. Concurrently, negotiations are under way with the Federal German Government regarding establishment of a laboratory for the investigation of transuranic elements at the Karlsruhe research centre of the Federal Government. Euratom is also negotiating with the Dutch Government, and it is believed that the agreements with the United Kingdom, Germany and the Netherlands will be similar to the existing arrangement with the Italian Government regarding the Ispra centre, and with the French Government regarding thermonuclear research at Saclay. The agreements will make provision to avoid duplication of thermonuclear work in France and Britain, and will provide for the interchange of scientists.

Energy Forecast in Error by only Ten Years

"I must reassert my belief that nuclear power will prove in the long run to be of decisive importance in ensuring the economic survival of the United Kingdom." Professor J. M. Kay, delivering his presidential address to the Junior Institution of Engineers on 11 December, based his view on the opinion that the long term estimate of energy requirements in the United Kingdom was correct. Certain developments, such as world recession in trade, mild winters, and peace in the Middle East, have postponed the date at which a major new source of energy will be required only by some ten years. The long-term world energy picture remains unaffected and will require a steadily increasing supply of fuel in future years. Professor Kay warned against the illusion that large power stations could be built without first testing the design in a series of prototypes, and felt that Britain's entry into large-scale investment in nuclear power ten years before it could be justified by demand was "absolutely necessary." Professor Kay is head of the department of Nuclear Power at Imperial College, London.

German Nuclear Programme Taking Shape

Concrete support for the joint Euratom-USA venture for building a 150 MW(e) station at Stuttgart was promised by the Federal German Government in the form of a guarantee amounting to DM100 million (£8·5 million). At the same time the Bundestag passed the oft-delayed atomic law governing the peaceful use of atomic energy, insurance, handling of radioactive materials, and waste disposal. The position of the law is analogous to the Radioactive Substances Bill proposed by the UK Government (Atomic Review, 27 Nov. '59) in that both replace a temporary legal structure for the control of radioactive materials which was based on the powers of local governments.

GEC Establish Japanese Branch

With a capital of £10,000 GEC have incorporated the British General Electric Company of Japan in anticipation of the contract to construct the Tokai Mura power station. The Japanese Government has issued a letter of intent for the purchase of the GEC design, and signing of the final agreement is expected shortly. The Japanese Atomic Energy Commission submitted its recommendation for purchase to the Government on 5 December, and construction of the £35 million station is expected to start in the spring.

Nuclear Power in Seven Year Plan: 2,000 MW

During his visit to the USA, Professor Emelyanov disclosed that approximately 3 per cent of power generating capacity to be installed under the new seven year plan will be nuclear. The plan calls for installation of 60,000 MW, of which 2,000 will be generated in nuclear stations of undisclosed type.

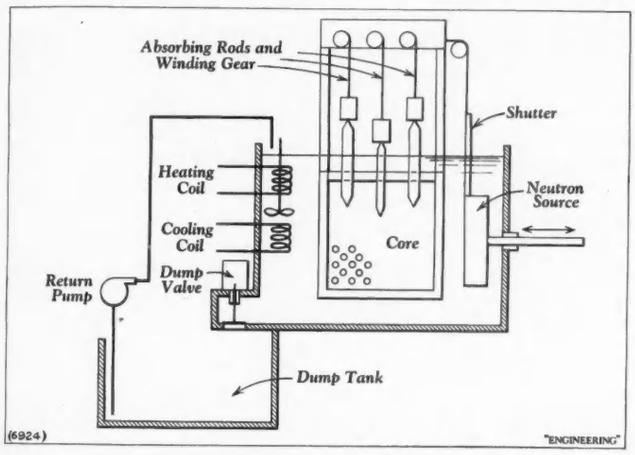
Low Frequency Supply for Control Gear

Electronic equipment for the low frequency power of the control rod motors for APC's Trawsfynydd power station will be supplied by Bruce Peebles. The equipment is valued at £100,000.

Protactinium and Technetium Isolated

Twenty grams of the artificial element technetium and 100 grams of the naturally occuring rare element protactinium have been separated by the UKAEA. Technetium (atomic number 43; mass number 92; 13 known isotopes) was first discovered in 1937 at the University of California when a molybdenum target was bombarded with neutrons. Until recently, the United States had the only source of the material. The Windscale process was based on concentration of 100 tons of fission waste by ion exchange followed by nitric acid leeching. Final purification was by solvent extraction using methyl-ethyl ketone to yield roughly 20 grams of technetium.

Protactinium (atomic numer 91; mass number 231; 12 known isotopes) occurs naturally in radioactive equilibrium with uranium, but owing to its short half-life (1 to 22 days) exists only in small quantities. At Windscale, protactinium was separated from certain waste products of uranium processing. The protactinium was removed from nitric-acid solvent by means of a carrier precipitate which was then treated for redissolution in hydrochloric acid and subsequent extraction into di-isobutyl ketone. The yield of 60 tons of raw waste was about 100 grams of protactinium worth £100,000, which is believed to represent the bulk of the world's supply of the material. Both protactinium and technetium will be available to universities for analysis.



Subcritical water-fuel assembly Eureka for variable moderator temperature. The drawing is purely schematic.

New Isotopes

The production of promethium 152 and 154 is reported by R. G. Wille and R. W. Fink (*Phys. Rev.*, p. 1950, No. 6, vol. 112). The isotopes were obtained by irradiating samarium 152 and 154 with 14·8 MeV neutrons; the half-lives observed were $6{\cdot}5 \pm 0{\cdot}5$ and $2{\cdot}5 \pm 0{\cdot}5$ min. In the same issue (p. 1954), N. T. Porile reports the production of a new germanium isotope—germanium 65—by the (α, 3n) reaction in zinc 64. The isotope decays by positron emission (half-life $1{\cdot}5 \pm 0{\cdot}2$ in) to gallium 65. The ground-state transition occurs in over 90 per cent of the disintegrations and has a positron end-point energy of $3{\cdot}7 \pm 0{\cdot}4$ MeV. Also in the same issue, R. B. Duffield and S. H. Vegors Jr. record several new isomers (p. 1958). They were looking for activities with half-lives greater than about 5 microsec between the 180 cps 1 microsec X-ray pulses of a 22 MeV betatron. The isotopes recorded are of bromine, niobium, indium, and tin. In *Z. Naturforschung* (p. 351, No. 4, vol. 12a) J. Flegenheimer and D. Geithoff state that they have observed, from the beta-decay curve after irradiating ruthenium 104 with fast neutrons, an isotope with a half-life of 1·2 min, which is probably technetium 103, produced by a (n, np) reaction.

Isotopes Produced in Particle Accelerators

Increasing use of isotopes produced in chain reactions has eliminated in many fields the use of cyclotrons as isotope sources. Chain reactions involve predominantly neutron capture or fission; as a result the isotopes produced tend to be neutron rich, and will decay by the emission of negative electrons. In certain medical techniques which involve accurate counting of accumulated isotopes, it is advantageous to use a tracer that will decay by the emission of positive electrons. Annihilation of the positive electron is accompanied by emission of two 511 keV photons which can be detected accurately and with low interference by two scintillation counters using the coincidence criterion for rejecting spurious counts. Isotopes that decay by positive electron emission are neutron-deficient, and cannot be produced in chain reactions. For such purposes the medical particle accelerators find increasing use. (*Cyclotron-Produced Isotopes in Clinical and Experimental Medicine*, by G. R. Newberry, *British Journal of Radiology*, vol. 32, No. 382.)

Small Power Reactor Programme in America

Boiling water reactors have a small cost advantage over pressurised water and organic moderated reactors in the 20 MW range, the generating costs being 13·4, 14·4 and 14·9 mills per kWh respectively. An evaluation report of the USAEC considers the advantage insufficient to override other considerations, and recommends construction of a pressurised-water plant with fossil fuel superheat in the commission's new small-size nuclear power-plant programme: SSNPP for short. Chief reason for rejecting the boiling-water reactor was the desire to avoid duplication of the Elk River project, built under the Power Demonstration Programme. Other reasons were construction experience, the ability to use standard turbo-equipment, and fuel cycle advantages. The report makes it clear that if instead of a small-scale power plant an experimental reactor were to be built, a direct-cycle high-pressure boiling-water plant using fossil fuel superheat would be recommended. In the end, the two types are expected to merge: pressure of the BWR is being raised; and the tendency is to reduce the margin for the suppression of boiling—which will result in some nucleate boiling—and to consider natural circulation in the pressurised-water reactor.

Eureka: a Flexible Research Tool

Core conditions approaching homogeneity as well as the usual heterogeneous lattice can be investigated with the new subcritical light-water facility Eureka. Flexibility is extended by the provision of heating and cooling coils which permit measurements with moderator temperature variable from 0 to 80° C. The core and tank, shown alongside is placed over a dump-tank of concrete. The core consists of a perforated metal box in which fuel assemblies are suspended. Loading of fuel is through a detachable side of the box. Removal of the side-panel trips the moderator dump valves, preventing access to the core when the flux is high. A pump then returns the moderator to the core. Although the assemoly is subcritical, two gravity-operated safety blades and one motor operated control blade are hung from a simple frame. The neutron source is mounted to one side at a variable distance from the core. The source is enclosed in a lead shield and a winding gear is provided for raising the lead shutter forming one side of the shield. The fuel for the lattice experiments will consist of enriched uranium-aluminium alloy in strip or plate form. Eureka, built by Vickers-Armstrongs (Aircraft), is installed at the Harwell laboratories of the UKAEA.

Comparing Neutron Source Strengths

In a paper "Scintillation Counter Method of Intercomparing Neutron Source Strengths by Means of a Manganous Sulphate Bath," E. R. Mosburg, Jr., describes how a 1½ in by 1½ in NaI(Tl) counter provides counting rates for determining bath activity which are higher by a factor of 9 than those of the geiger counter previously used. The method also results in a reduction of the ratio of background to total count from 12 per cent to 3 per cent (when the bath, 1 m. diameter by 1 m. deep, is activated by NBS-1). The paper appears in the *Journal of Research* of the National Bureau of Standards (p. 189, 5 May, vol. 62). The sharp 662 keV gamma line of caesium 137 used as a reference pulse height—to which the scintillation counter system is adjusted by means of a two-channel pulse-height analyser—makes the reliable reproduction of results from day to day possible. By using the scintillation counter, the ratio of the emission rate of the national reference standard neutron source (NBS-II) to that of the national standard neutron source has been redetermined and found to be $0{\cdot}939_3 \pm 0{\cdot}001_7$.

XUM

Toys that Demand Engineering Precision

Toy design is no longer left to chance but all the parts are accurately engineered, whether they are locomotives, mechanical spiders or diesel engines for aircraft. Full use is made of modern machine shops and new materials.

Some years ago A. A. Milne mourned the passing of the simple building bricks of his youth. What would he say now to the complicated pieces of mechanism that are called toys? The industry that was once the prerogative of Germany has changed hands; it involves the employment of thousands where before there were tens, and engineers are needed to cope with the problems set by the modern child.

To show some of the detail Fig. 2 is an electric locomotive built exactly to 4 mm scale —even the rivet heads on the moulded body are correct to within one-thousandth of an inch. And this is mass produced at a price most people can afford.

But it is when the details of construction and design are considered that the full engineering import is realised. This first section deals with model locomotives; the remaining two cover aircraft diesel engines and speciality mechanical toys. All are products of the Lines Brothers Group. There is nothing in the manufacture of any of them that is haphazard; exact design is the common factor.

With all these models the object is to obtain the power and reliability while working strictly to scale outlines, as was stressed in the article on page 628 (11 December). In the Tri-ang locomotives (made by the associated company Royex Limited) the motors have to be made to limits that not so long ago were thought to be too fine for any machine shop. The magnet of the motor is made of Alcomax III which is a sintered alloy—a process almost unheard of 20 years ago. Mild steel pole pieces extend over the armature. The shaft runs in sintered phosphor bronze bearings which are porous to allow oil to flow, and are lubricated by a pad. The accuracy of the bearings is within 0·001 in. The shaft itself is held to $\pm$ 0·0003 in.

The armature is built up of laminations and the coils are hand wound in a machine. The drive to the wheels is by worm and wheel; in most models a two-start worm is used but in some, including the steeple-cab shunting locomotive, the worm has only one start, so giving greater pulling power. The brushes are carbon and are held in place by springs.

Since Tri-ang use the two-rail system (that is, the two running rails are insulated from each other and one supplies the feed and the other the return) it is necessary to insulate all the wheels on one side. This is done by using a plastics bush—which again would not have been possible 20 years ago. The current is picked up from the wheels by phosphor bronze strips rubbing on the inside. The wheels themselves are allowed a maximum eccentricity of only 0·003 in.

But it is in the moulded bodies that detail comes to the fore. The development of the plastics industry and of moulding techniques has enabled minute detail to be reproduced with extreme accuracy. The rivet heads have already been mentioned. Bolt heads are correctly shaped, too, and may be only 0·020 in across, but the peak of fine representation must surely have been reached with one model which has a maker's name plate with lettering—perfectly clear under a magnifying glass—only 0·010 in high.

Fig. 1 Remote control and competition join to make toys fascinating for the whole family.

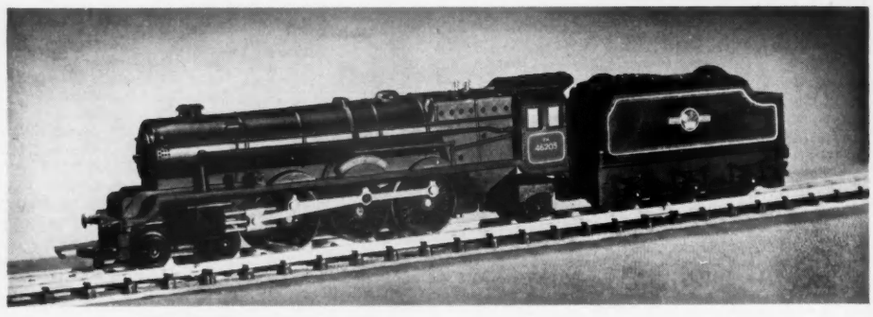


Fig. 2 Modern models demand exact reproduction.

Little Engines With Big Performances

The automobile engine manufacturer is really quite happy when he manages to squeeze 40 b.h.p. out of one litre of internal combustion engine: he is quite amazed when the tuning wizards manage to extract 90 b.h.p. from the same litre; but the man who makes model aeroplane engines finds an output of 120 b.h.p. per litre commonplace. If he is pressed he can give 140 b.h.p. per litre. Engines like these are a lot more than children's models; they are beautiful examples of precision engineering.

The engines work on one of three principles, being either spark ignition, compression ignition (diesel) or glow plug. The first method is rarely used nowadays; the second is the most popular, normally using a two stroke cycle; and the third is used when a very high speed engine is wanted, though a diesel of the same size would normally give more power (some such engines are capable of 20,000 r.p.m.). The ignition system of the glow plug engine works on a principle not often found in internal combustion engines. For starting a voltage is applied across a plug in the cylinder head which causes the plug to glow, but once the engine is running the voltage source can be removed, because the heat from the explosions plus a catalytic reaction occuring between the plug and the fuel keeps the plug glowing without the assistance of a battery. The capacity of these engines does not often exceed 15 c.c. and the majority of them fall into the under 5 c.c. class.

Typical of these engines is the Frog 349, a 3·5 c.c. diesel engine made by International Model Aircraft Limited of Wimbledon. It is shown assembled and broken down into its components in Figs. 3, 4 and 5 on the opposite page. This is a high-speed loop-scavenged rotary valve two-stroke compression ignition engine, with a bore of 0·666 in and a stroke of 0·600 in. It runs on an interesting brew of 35 per cent ether, 30 per cent paraffin, 32 per cent castor oil and 3 per cent amyl nitrate. The air and fuel are mixed in a spray-type carburettor at the rear of the engine. The mixture is sucked into the crank case as the piston is on its way up for the compression stroke. When the piston is nearing the top of its travel the rotary inlet valve is closed off before the power stroke is started. At the bottom of the power stroke the piston uncovers first the exhaust port and then the inlet port in the cylinder liner. The compressed mixture from the crank case enters the cylinder and helps to force out the expended mixture. Compression then starts once more.

The engine is made up from nine main parts shown in the accompanying illustration. These are put together with the aid of a few screws and gaskets to form the complete engine which is also illustrated. The crankcase, cylinder head and the rear rotor housing are aluminium alloy pressure die castings. The crankshaft, valve rotor and cylinder liner are made from case hardened mild steel, the piston is quality cast iron, and the cooling fin sleeve is another light aluminium alloy. The two crankshaft bearings

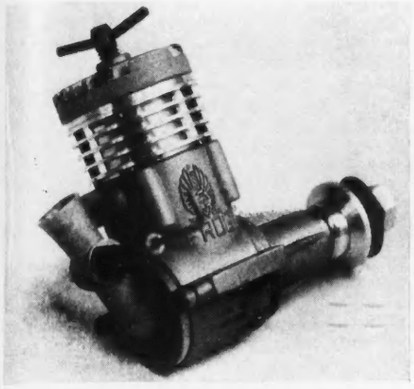


Fig. 3 The Frog 349 model diesel engine.

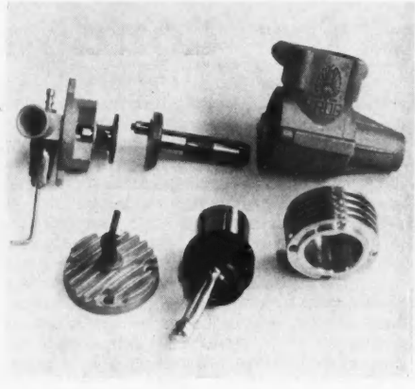


Fig. 4 The main components of the engine.

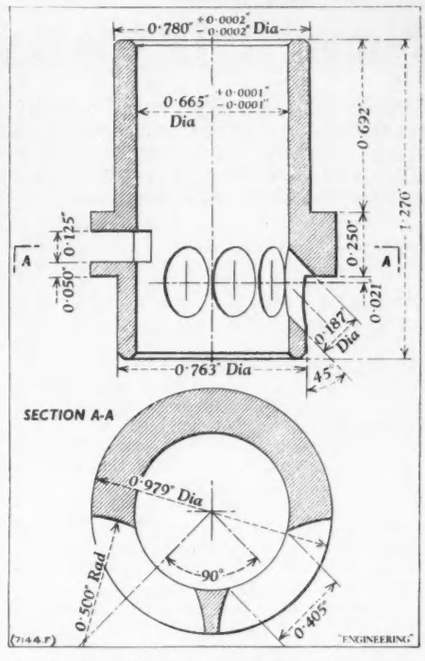


Fig. 5 The cylinder liner and piston of the engine are ground to ± 0·0001 in and then matched by honing the liner.

are a Hoffmann ball bearing and a Vandervell steel backed bearing.

The engines are made in a machine shop which forms part of Lines Brothers factory at South Wimbledon. The quality of the engineering done here is typified by the machining of the liner of this engine, of which a drawing is shown. The mild steel liner is case hardened to a depth of 0·008 in. The outside diameter of it is turned on a Footburt automatic to 0·786 in and then ground on Scrivener centreless grinding machines down to 0·780 ± 0·0002 in. The inside diameter is reamed to ⅞ in diameter and then ground on a Churchill automatic sizing internal grinder down to 0·665 in ± 0·0001 in. The diameter is checked as ground on a Solex air gauge.

The cast iron piston, made of Meehanite, is turned on a Herbert capstan lathe to 0·674 in before being ground on another Scrivener centreless machine to 0·666 in ± 0·0001 in. The piston and liner for any one engine are matched by honing the liner on a Delapena honing machine.

Mechanical Specialities

A wide variety of mechanical toys is made by the company and, from the design point of view, there is much of interest. Raw materials are bought outside but wheels, gears, shafts, pinions and bushes are made and assembled into such parts as the standard clockwork mechanism, used in so many of these toys. For example, one such unit drives the Sherman tank which also has a separate wheel of carborundum powder, inside a plastic cover, to give the effect of sparks as the tank moves along, propelled by rubber tracks running on free bogies. The tank is fitted with a mechanism for puffing out what looks like smoke, but which is really talcum powder. The mouse, also driven by a clockwork motor, has a shaft on which there are two cams operating rivets inserted in the chassis. The cams take it in turn to push out a rivet so that it makes contact with the table and pivots the mouse, making it gyrate from side to side.

Metal stampings are used on many of the toys, some of which, in fact, consist almost entirely of stampings except for such items as tyres. Typical examples are the aircraft refueller and transporter. The aircraft breakdown van, which operates a crane, uses stampings and diecastings (made by Lines) of Mazak, a zinc-based alloy. The steam roller, which moves backwards and forwards by the action of a half crown-wheel and two pinions mounted on the same shaft, has an all metal body (stamping) and plastic wheels of cellulose acetate. Plastics are used also on the diesel flyer, which is inertia driven. The body is of cellulose acetate or general purpose polystyrene, which takes a high gloss finish. An interesting feature of the flyer is the plastic soundbox operated by a brass trembler that gives the model its characteristic whine. An ambulance, also inertia driven, has a plastics body made in two halves about the vertical centre-line. Transfers are used for the red cross and number plates. The walking toy mechanism is used on the beetle, jabberwock and tortoise. The drive is by a toggle action through an S shaped connecting link that works the legs and head.

There is a wide range of electrically-driven motor cars, such as the Rolls-Royce, Austin Healey, Ford saloon and convertible, most of which have a general purpose polystyrene body and rack and pinion steering. The cars are powered by two or three 1½ volt batteries, set in a recess in the chassis, driving a small electric motor, wound and made in its entirety by Lines. The cars have diecast hubs and steering wheels and the bumpers and hub covers are vacuum plated (metallised) in pure aluminium, to give them a white chromium look. They have a control lever to give forward and reverse.

Boys, and their fathers, can get all the thrills of motor racing with the Triang Scalextric model car racing outfit. There are two tracks, side by side, as shown in Fig. 1. Each track has a pair of guide rails, from which a swivelling guide wheel picks up the current for driving the cars. Each car is controlled by its own push-button and it takes quite a lot of skill to keep a car on its track when cornering. Almost any well-known race track can be reproduced in miniature, complete with drum barriers, a hump-backed bridge, pits, control tower, event board and grandstand, all accurate as to detail.

The series of "Spot-on" models consists of road sections, cars, commercial vehicles, traffic lights, direction signs and buildings, all made accurately to a scale of 1/42, so that each item is, in itself, a collector's piece. With the accessories available, it is possible to build up a complete highway system. The Cotswold village in Fig. 6 is an example of first-class moulding in latex. The outfit is, in fact, popular for demonstrating road safety and on many occasions has helped the police solve traffic problems.

Fig. 7 shows just how realistic a harbour scene can be, using the Minic waterline and ships. The diecast ship models, which include the massive Queens as well as tiny minesweepers, are made accurately to 1/1,200 scale down to the last detail, every porthole, for example, being the correct size and in the correct position. The series includes breakwaters, customs sheds, warehouses, lighthouses, storage tanks and quay sections: everything, in fact, that is needed for realism.

For those who take model engineering seriously the National Models Exhibition is being held at the New Horticultural Hall, London, SW1, from 31 December to 9 January.

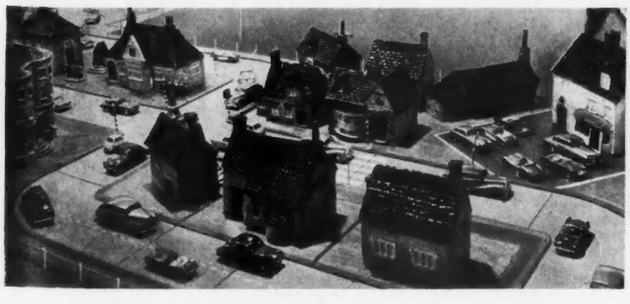


Fig. 6 The houses in this model Cotswold village are moulded in Latex.

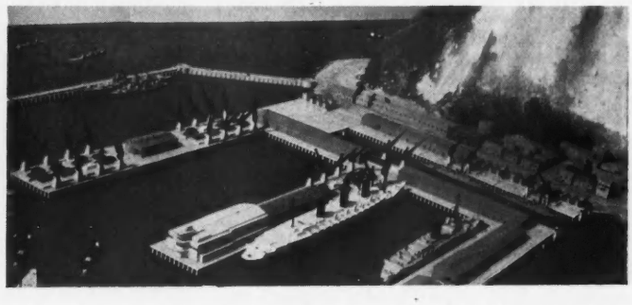


Fig. 7 Realistic harbour scene using the series of 1/1200 scale models.

New Highways for London

Urban motorways, multi-storey parking facilities and traffic-free pedestrian precincts are all needed to give London a 20th Century road system.

London—if only because of its size—probably presents the most complex urban traffic problem that can be found anywhere. Other cities have got worse local black spots and, elsewhere, main shopping thoroughfares can be found where traffic is more regularly snarled to a standstill than even in the worst sections of London. Nowhere, however, does there exist such a mileage of roads that have to handle 3,000 and 4,000 vehicles an hour in each direction.

Of recent years the volume of road improvements being undertaken within the London County Council area has been about £4 million per annum. A number of isolated projects—some costing £5 million or more, such as at Hyde Park Corner or the duplication of the Blackwall Tunnel—are begun or sufficiently well detailed that they could be put out for tender in a relatively short period. Nevertheless, such is the magnitude of London's problem that a £5 million project—sufficient to resolve some town's traffic difficulties for all the foreseeable future—makes hardly any impression at all on the movement of the capital's traffic. Not that such projects should be deferred on that account. But attempts should be made to fit them into a single overall plan for the long-term development of highways in the London area.

It was in an attempt to determine such a long-term plan that the Roads Campaign Council sponsored their "New Ways for London" competition, the results of which have just been declared.

When launching the competition, the Council said that the successful entry would have to produce a plan that took into account the existing character of London, while at the same time recognising that some buildings and some people had to be affected for the common good. The new roads envisaged in the plan had got to be able to bring people into the heart of the city in reasonable times from the suburbs and get them back again. Shoppers had to be able to get to the great centres of central London by bus and car if they wished. Pedestrians should be able to move freely and safely along the pavements. Commerce and public services were not forgotten either: lorries and vans required good roads to get to their destinations without undue delay (and the necessary accommodation to be taken off the thoroughfare while they were being unloaded), and such roads would also enable London Transport to give a better service. The important thing was that traffic must have somewhere to stop at the journey's end.

The results of the competition have now been declared and the two photographs on this page illustrate how the first and second prize-winners propose that two central areas of London should be handled: the Holborn-Fleet Street area and, secondly, an area that includes Trafalgar Square, Piccadilly Circus and Regent Street.

Under the conditions of the competition the competitors had to first map a modern long-term network of motorways and parking facilities for the whole County of London and submit a 6,000 word report detailing the scheme. Candidates who reached the final selection—five entries out of a total of 54—had to build a scale model of a 1½ sq. mile area within 6 miles of Charing Cross to show how their scheme would finally work out.

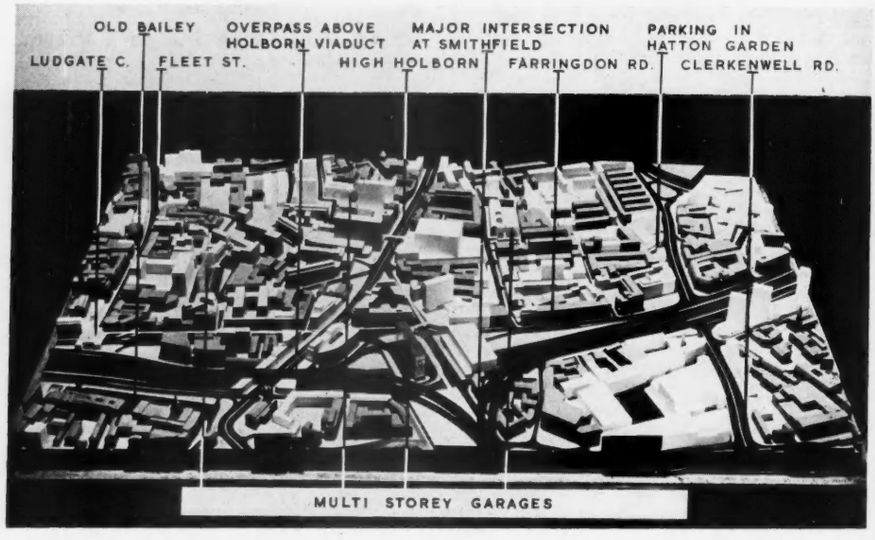
The first prize went to Mr. J. A. Proudlove, a lecturer in civil engineering at Liverpool University, who receives £2,000. He is a former winner of the Charles Hawsley Prize of the Institution of Civil Engineers and author of several papers on motorways and traffic designed for special roads. Mr. Proudlove bases his plan, not on the conventional ring road and radial system, but on a loop or tangent arrangement, with twelve radials connected in pairs across the central area and restricted interchanges between the roads. Some of his new routes are elevated motorways built over the main line railways. He also makes considerable use of direct underpasses on the main traffic streets leaving the turning traffic to minor roads. Motorway intersections have fronting collector roads. Parking spaces are related to the proposed volume of building and traffic envisaged. And, finally, the rights of pedestrians are respected by denying vehicles entry to whole areas, except for the purpose of reaching prescribed parking areas.

The area chosen by Mr. Proudlove to represent by model—shown in the upper illustration—is one that includes Fleet Street, Farringdon Street, Holborn and the Clerkenwell Road. Known plans for the area are integrated with the author's suggestions for limited-access highways and do so without seriously disrupting the existing pattern of buildings. Between 20 and 30 years are allowed for the project.

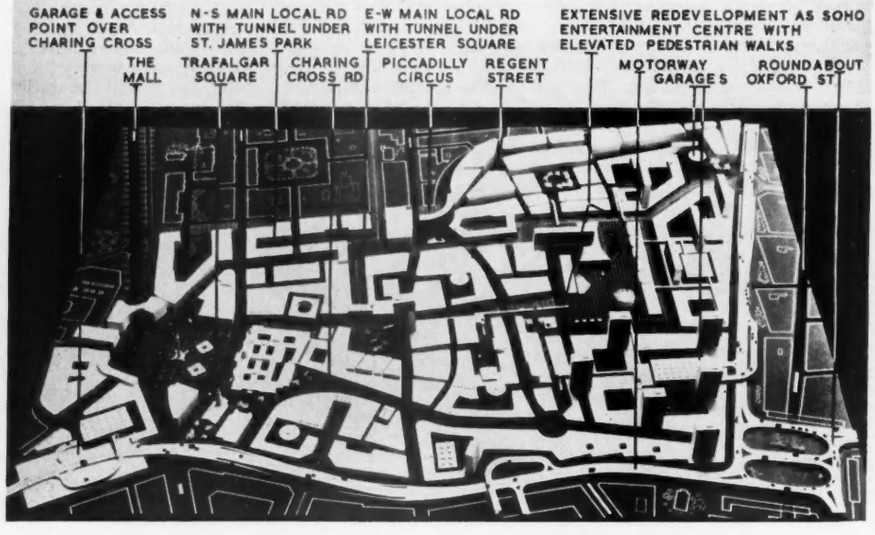
In contrast to the winner, the runner-up in the competition, Mr. W. K. Smigielski, head of the Leeds School of Architecture and Town Planning, bases his scheme on a modified "grid iron" pattern of major highways. The judges described this entry as the best presented of any received. It sets out to convince all concerned that London can have a new look as well as new traffic ways, so that the whole environment will be more pleasant, pedestrians especially coming into their own again. For his entry Mr. Smigielski receives £1,000.

Among the other ideas contained in the other successful entries is one that requires large interchange and parking facilities on the fringe of the central area, for example, over Euston Station, but with comparatively narrow elevated highways in between, some of which are for one-way traffic only. Another of the entries assumes that a special motorway bus service will be provided which enabled the whole scale of the proposals to be smaller than if the increase in private transport is regarded as inevitable.

The Roads Campaign Council have arranged for the drawings, sketches and models to be exhibited in Charing Cross Underground station from 21 December until 30 January. They are also arranging for the publication of Mr. Proudlove's report in full, including its drawings.



Model of the winning entry in the Road Campaign Council's competition for replanning the road system of London. It shows how the Holborn-Fleet Street area might look 20 or 30 years from now.


GARAGE & ACCESS POINT OVER CHARING CROSS
N-S MAIN LOCAL RD WITH TUNNEL UNDER ST. JAMES PARK
E-W MAIN LOCAL RD WITH TUNNEL UNDER LEICESTER SQUARE
EXTENSIVE REDEVELOPMENT AS SOHO ENTERTAINMENT CENTRE WITH ELEVATED PEDESTRIAN WALKS
THE MALL
TRAFALGAR SQUARE
CHARING CROSS RD
PICCADILLY CIRCUS
REGENT STREET
MOTORWAY GARAGES
ROUNDABOUT
OXFORD ST

The second-prize model: the Trafalgar Square-Piccadilly area of the future?

New Divisions for Cementation Group

The Cementation group of companies is establishing a permanent headquarters for research at Maple Cross, Rickmansworth, Hertfordshire.

A staff of 50 will be housed at the centre which will consist of offices and laboratories on two floors having a total area of 18,000 sq. ft. In addition to the research activity the centre will accommodate the group's soil mechanics section.

Construction, begun early in December, is being undertaken by the Demolition and Construction Company, a member of the group. The building is scheduled for completion by October, 1960.

The company have also formed a ground engineering division. The division which is based on the group's headquarters in London, has two main departments—cementation and geotechnical. Activities of the soil mechanics and Vibroflotation sections will be taken over by the new division, which will also tackle problems of ground treatment. For this purpose a section to be known as "Process Design" has been formed.

Work to be undertaken by the division includes all types of grouting, exploratory drilling for soil investigations and cementation, and anchor stressing for the construction of dams. Currently the group are working at Kariba, treating the foundations of the dam and the power house; site drilling and grouting for the Cameron Highlands hydro-electric scheme in northern Malaya; and anchor stressing on the Catagunya dam, Tasmania.

Tenders Invited for Medway Motorway Bridge

Tenders are to be invited for the construction of the Medway bridge which will carry the Kent motorway—the M2—over the river near Rochester.

The bridge, perhaps the largest yet built in Britain if the estuary bridges are excluded, will have three river spans, one of 500 ft and two of 313 ft each; it will also have 17 spans of between 100 ft and 133 ft in the approaches. Dual two-lane carriageways will be provided over the bridge for the motorway; cycle tracks and footpaths will also cross the bridge but will be separated from the main carriageways. The roadway will be 116 ft above the river.

Reinforced and prestressed concrete will be used for the approach viaducts, but alternative tenders based on prestressed concrete or welded steel will be considered for the superstructure of the three river spans.

The bridge has been designed for the Ministry of Transport by Freeman, Fox and Partners of London, who will also supervise its erection.

Architect-Engineer Relationship

One way of increasing architect-engineer co-operation on building projects is for the consultant to be staffed with members of both professions. Among others, this is what E. R. Collister and Associates have done. They call themselves "chartered architects and industrial consulting engineers."

Of the two senior partners, one is an architect, the other an engineer. Of the staff, some 35 per cent are engineers, with both structural and services engineers represented. The advantage is that it does away with the idea that the architect just hands a design over to the engineer and challenges him to make it stand up. Collisters believe that the advantages arising from the cooperative operation far outweigh the disadvantages of engineers always working with one group of architects.

A new building under construction at Fulham, London, for the North Thames Gas Board is an example of the firm's work. For the structural engineer the main problem was to obtain a clear span of 50 ft with the very minimum of construction depth on each of the floors. The structure adopted has precast prestressed concrete ribs at 3 ft 4 in centres. These act in conjunction with the cast in-situ floor deck to form T-beams. Depth of construction is 2 ft. An idea of the economy of the system can be gained from the overall weight of the floor structure—less than 70 lb per sq. ft for the 50 ft span, rather less than the weight of a 6 in solid slab.

Trollope and Colls, the general contractor, planned the site operations so that the specialist subcontractors, Pierhead Limited, could lay down prestressing beds on the site within direct reach of tower cranes.

Civil Engineering Models and Activity

A documentary of the construction of the London to Birmingham motorway, and entitled "Motorway," is one of the new films available from members of the Federation of Civil Engineering Contractors. The federation has issued a revised catalogue that contains details of 92 films and 16 models which may be borrowed; together they illustrate the varied activities of the civil engineering contracting industry—harbour work, roads, bridges, water supply and sewerage schemes, airports and power projects.

During the third quarter of this last year, the Ministry of Works returns show that constructional work valued at £504 million had been performed, representing an increase in the volume of production of 6 per cent on the corresponding period last year. Also in the third quarter of this year contractors obtained new work valued at £371 million. Few very large contracts were let during the quarter, but the figure was £60 million up on the same period last year.

Progress at Hinkley Point

The illustration shows one of the massive concrete structures in the turbine hall at Hinkley Point nuclear power station. It is one of six that will support the 93·5 MW turbo-alternators that are being built by English Electric. Work at site was begun two years ago.

Turbo-alternator block at Hinkley Point.

The station—the world's first 500 MW nuclear station—is being built by the English Electric-Babcock and Wilcox-Taylor Woodrow group. Out of the country's 6,000 MW atomic power programme, stations to generate 1,400 MW are under construction.

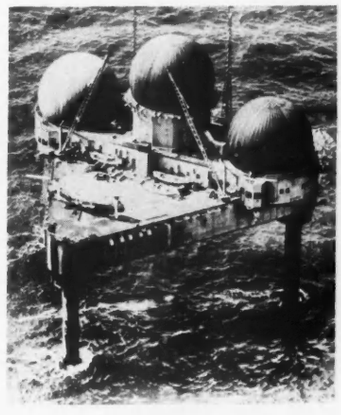
Materials for the Commonwealth Institute

When the plans for new Commonwealth Institute building were made public (ENGNG., 19 June, p. 804) it was known that the 25 tons of copper for the paraboloid roofs would be given by the Northern Rhodesia Chamber of Mines. Since then the Enfield Rolling Mills have offered to convert the copper into the sheets required free of cost.

Other gifts are the whole of the aluminium (20 tons) from Aluminium Limited of Canada, the bauxite originating from British Guiana or Jamaica. Also from British Guiana is coming 2,000 sq. ft of greenheart for the floor of the restaurant. Between 40 and 50 tons of vermiculite is being presented by the Transvaal Ore Company through Mandoval of London. For the floor of the director's suite, Akberali Hassanali of Mombo, Tanganyika, are giving 800 sq. ft of muhuhu timber.

Protection against Sea Corrosion

A tough coating made of vinyl resins has given maintenance-free protection to a radar installation in the North Atlantic for more than 14 months. The coating used previously lasted only 14 months before it broke down and severe rusting resulted. Expected to last five years, the new vinyl coat, which is made by Union



Protection against corrosion is provided by a 0·040 in thick vinyl resin paint. The coat is expected to last five years.

Carbide of New York, has withstood extreme temperature changes and salt water action without damage. Altogether the paint was used to cover 17,000 sq. ft and was applied to a thickness of 40 mils (0·040 in) on top of a vinyl red lead base.

Liason between Structural Associations

Five of the principal international associations catering for structural engineers have established a joint committee to discuss points of common interest. Especially will the committee consider the forthcoming programmes of the five associations to minimise the overlap of the topics to be discussed, and also to eliminate meetings that clash in time and place.

The five associations are the Association Internationale des Ponts et Charpentes (AIPC); Fédération Internationale de la Précontrainte (FIP); Réunion Internationale des Laboratoires d'Essais et de Recherches sur les Matériaux et les Constructions (RILEM); Comité Européen du Béton (CEB); and the International Association of Shell Structures (IASS).

The NSU-Wankel Engine

A completely new internal combustion engine, invented by Felix Wankel, has been developed jointly by the NSU Motor Company and the Curtiss-Wright Corporation of America. Having no reciprocating components, it appears to be a major breakthrough in internal combustion engine design.

The NSU-Wankel engine, as it is now being called, has only two moving parts—a rotor and an output shaft. It does away with valves, valve springs and camshafts and its power to weight ratio is much higher than that of a comparable conventional i.c. engine. It was described, in principle, in ENGINEERING, p. 580, 4 December, 1959.

The first rotary engine of this type was put on the test bed at NSU's works in February, 1957, and was successful enough to encourage further efforts. These efforts soon resulted in the development of a 125 c.c. engine which had an output of 29 b.h.p. at a shaft speed of 17,000 r.p.m. The specific fuel consumption of this engine was 230 gallons per b.h.p. per hour and its m.e.p. figures exceeded 130 lb per sq. in. This, the first practical design, had three moving parts: a shaft, an inner rotor and an outer rotor; but it has now been superseded by the present design in which the outer casing remains stationary and only the shaft and rotor move.

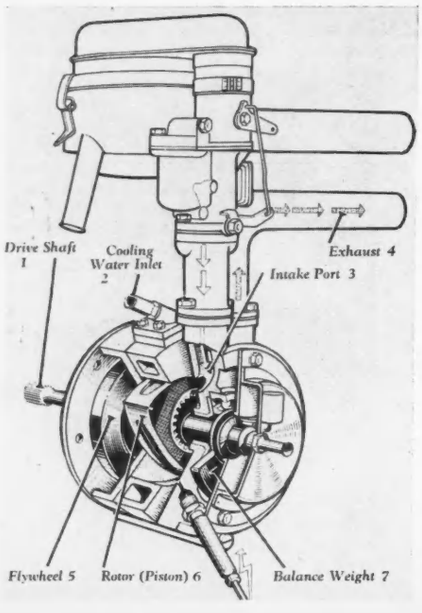
The shape of the bore is epitrochoidal; a configuration which was mathematically identified by Professor Boier of Stuttgart as being the one required to keep the three cornered rotor in constant touch with the stator. The speed of the rotor is two-thirds of the speed of the shaft (i.e., about 11,300 r.p.m.), so that surface speed is roughly comparable to that of a piston engine.

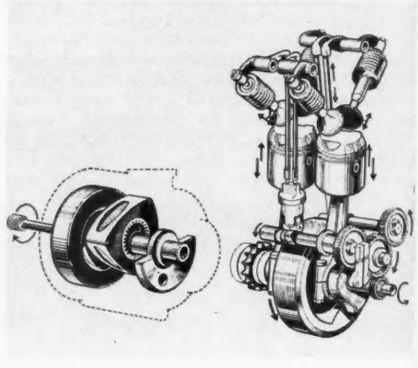
All four cycles take place during a single revolution of the rotor, which means that a certain amount of overlap between inlet and outlet (as occurs on a two-stroke engine) is unavoidable. Only the compression and the expansion strokes take their full phase. The engine therefore works in accordance with the four-stroke principle but can be compared with the two-stroke engine in respect to the exhaust and induction sequence.

The method by which the engine works can be followed quite simply from the four-part sectioned illustration: in square I, at point 1, there is a minimum volume contained between apex seals A and C. In square II, the exhaust phase is just about to commence as seal C uncovers the exhaust port. The volume contained by A and C has slightly increased. In square III, C has fully separated exhaust and inlet and both cycles are taking place. At the same time the volume contained between seals A and C has been fully compressed and so ignition takes place. In square IV, the volume contained between A and B is expanding and, since the distance from the output shaft centre to B is greater than to A, the rotor is driven in a clockwise direction.

Water cooling is used although it is thought that air cooling may be possible later. It would appear that the only suitable method of lubrication is by a petrol and oil mixture, as with two-strokes.

The NSU-Wankel engine could be said to occupy a position somewhere between the reciprocating piston engine and the gas turbine. It offers a degree of performance and economy over the wide range between these two types of engine, which they cannot satisfy. Its main challenge to the conventional piston engine is that it overcomes the limitations imposed by inertia forces on reciprocating masses; but in addition to this it is simpler and cheaper to make, has a much higher power to weight ratio, and is cheaper to run.



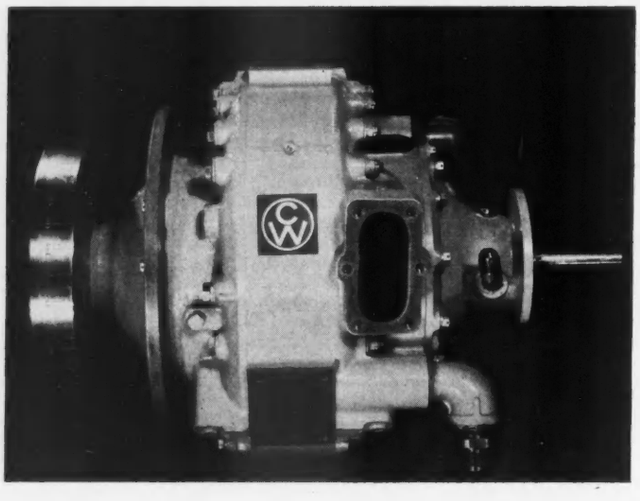


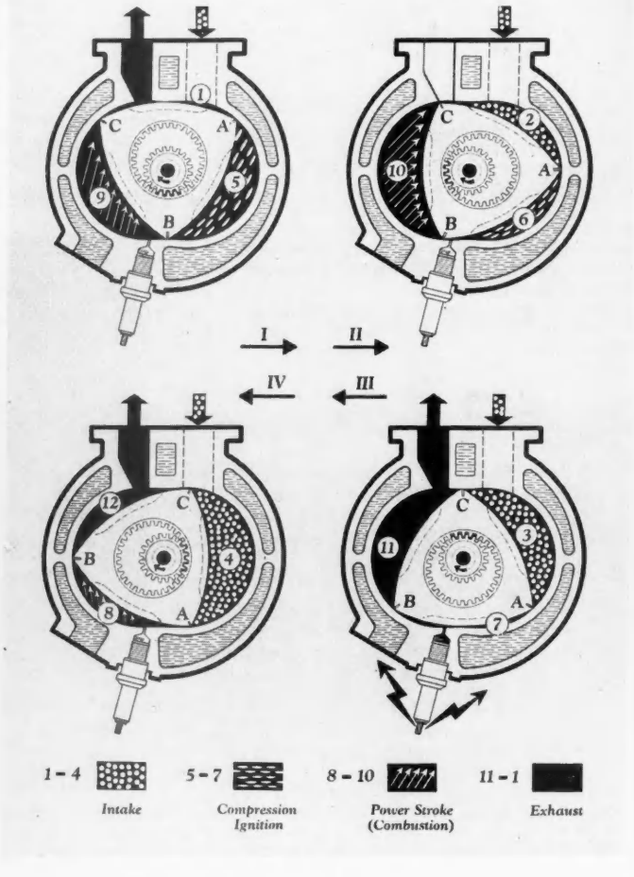
(*Left*) *Part cut-away view of the engine with carburetter and exhaust attachments.*

(*Top right*) *Comparison of rotary engine with vertical-twin motor cycle engine.*

(*Lower left*) *NSU-Wankel engine made by the Curtiss-Wright Corporation, USA, who are developing the engine for aircraft and marine use.*

(*Lower right*) *All four cycles take place during a single revolution of the rotor. The gearing between drive-shaft and rotor is 2 : 3.*





Blocks and Birmid

With their proven experience in making aluminium cylinder blocks for engines where lightness is essential, Birmid Industries are a leading witness in the case of aluminium for the cylinder blocks of popular motor cars.

The evidence by the Marquess of Exeter in his annual statement as chairman of Birmid was not, particularly encouraging. The present raw material cost in aluminium is higher than the traditional cast iron. Until the difference in basic cost is reduced by a significant amount, the chairman saw no certainty that saving in machining costs would make aluminium competitive with cast iron where the technical consideration of engine performance was not the main interest.

The light alloy foundries of the group largely specialise in aeronautical products and they have been, and continue to be, suffering from low demand. Other sections of the group found demand improving but it was only the modernisation schemes that have been carried through that enabled profits to be made in the face of very keen prices.

Competition has become extremely stiff in some markets. In Northern Europe wrought light alloys, which make up almost the whole of Birmid's exports, were being offered by foreign producers at prices which were only narrowly above the cost of the raw material to Birmid. The effects of the " Outer Seven " are not yet clear but it seems probable that the EFTA organisation should operate to the group's advantage in Scandinavia, where there is already a useful light alloy market.

Since a high proportion of Birmid's castings are sold abroad as parts in tractors, motor cars, aircraft engines and other products, there is a direct link between the company's future prosperity and the growing rate of industrialisation in most countries.

But there are snags. The Marquess of Exeter put his finger on one when he said that the biggest single threat to the future prosperity of industry was the increasing influence that the unofficial agitator has in bringing work to a stop, wiping out men's weekly pay packets for often the flimsiest of reasons.

The welcome given by the Marquess to the TUC's proposal to conduct a full-scale inquiry into strikes, official and unofficial, was given before Mr. Frank Cousins' Transport and General Workers Union had declined to answer the TUC's questions.

Cold Forging

Years ago Mr. John Dalgleish, the chairman of the Camp Bird industrial group, claimed that the cold forging process used by his firm, Cold Forging Limited, was not just a new method but a new industry in itself.

Nobody took very much notice and it looked as though the plant at Sunbury-on-Thames would have to make itself better known by making a series of products and putting them on the market. But suddenly, says the chairman in his annual Camp Bird statement, they were " inundated " with inquiries, and not only for cold forged products but for manufacturing installations.

The plans to make and market a range of products had to be dropped and the Sunbury plant was turned over to fulfilling the orders of motor car firms and others. Cold forging orders for motor firms in Britain, Germany, the United States and France are being carried out, many of the orders being part of agreements to provide the installations later. Negotiations on the financial side of passing on the cold forging techniques are being carried on with the press-making industry.

Components for disc brakes, for electrical equipment in cars, gudgeon pins and other parts are keeping the Sunbury works busy. Complete installations have to be supplied to one motor manufacturer within two years and the making of the disc brake components is to be followed by the supply of an installation. An organisation is being set up in the United States and offers of joint ventures for the exploitation of cold forging in Canada, USA, France and at home are under consideration.

At Ravensburg, West Germany, the group has a controlling interest in A. Nothelfer and Sohne, makers of press tools for the motor car industry, where the manufacturing capacity has recently been doubled. Nothelfer's capacity is fully booked for 1960 and is now receiving extensive orders into 1962 with the possibility that more plant extensions will be necessary. The firm makes a plastic extruder and it is just one of the complexities of European trade that a British firm has taken a licence to make the extruder for the Sterling area.

Upsurge in a Steel Department

The good news of the recovery which has finally reached the heavier sections of the engineering industries is coming in more and more often.

In its chairman's annual statement, the Walter Spencer company, after recounting a depressed year just past, is able to tell of improved conditions that are expected to go on getting better. An upsurge of orders in the steel department, mainly for heavy bars, forgings, rings and blank forgings has been experienced in the last few weeks.

While the company's high frequency melting, heavy press and forge departments have in the past year been working only single shifts and on a four day week the tool department has been hard put to it to stay busy for a full week. The chairman, Mr. Herbert Priest, complains that some " entirely unnecessary " price cutting took place, particularly in milling cutters, hobs and twist drills.

The agreement the firm has made with W. Ferd Klingelnberg Sohne, of Remscheid, Germany, to make special roughing hobs under licence promises unusual savings in the time taken for the roughing out in gear cutting.

Scooter Success

It is an even chance that more than half the motor scooters seen and heard in Britain are powered by an engine from the Villiers company. As the general consumer boom took in scooters as well as more weather-protected vehicles, the before-tax profit of the Villiers group rose by more than £300,000—from £448,000 in 1958 to £762,000 in the year up to 31 July, 1959.

A stimulating thought for the next session between the engineering employers and the unions in the pay claim talks is thrown out by the chairman, Mr. Leslie W. Farrer, in his annual statement. What is wanted is not, he says, a 40 hour week, but an 80 hour double-day shift week. This would plainly secure a much greater utilisation of costly plant, it should lead to the 40 hour week with lower rather than higher costs per unit.

What Mr. Farrer does not explain is where the extra men are to come from, unless he foresees in the very near future a much lower ratio of men to machines employed. Without a general acceptance of shift working in the engineering industries, Mr. Farrer sees any wage increases or shortening of hours as leading to a further " upward surge in prices."

No Prophecy

The chairman of Stothert and Pitt, Mr. R. A. Riddles, described the progress made by his company during the year ended 30 September as " a very solid achievement." Although profit margins have fallen a trading profit of £893,200 can be considered as most satisfactory and sales reached a new peak during the year. Mr. Riddles pointed out that trading in the group products—cranes, contractors' plant, pumps and deck machinery—is becoming increasingly competitive and said that in his view " the way to increase profits in future years will be to increase turnover."

Stothert and Pitt are important suppliers of pumps and deck machinery to the shipbuilding industry, and it may be this factor which has led Mr. Riddles to say that it is " more difficult than ever to prophesy with any measure of exactitude the prospects for the future." Another factor is the company's very substantial stake in export markets, where German and Japanese competition is increasing " largely due to lower labour costs and the granting of longer credit facilities." The latter is likely to affect the export performance of the engineering industry as a whole during 1960, and constitutes a problem which is perhaps not receiving all the attention it deserves from the Government.

Ships and Boilers

The recent fall in the tonnage of ship building in Britain has not acted as a boost to the morale of the shipbuilding community. The general feeling of despondency which prevails is unlikely to disappear until ship owners resume ordering new tonnage, and they may not do so for several months even if freight rates recover. Shipbuilders' point of view was put forward recently by Sir Harold Yarrow, chairman of Yarrow and Company, in his annual statement.

Having announced much improved profits—£315,600 for the year to 30 June as against £199,500 for 1957/58—Sir Harold went on to paint a dismal picture of the prospects of British shipbuilding. There is, he said, considerable excess of manufacturing capacity against present demands and " it will require the close cooperation of employees at all levels if we are to reap the benefit of the expenditure incurred in the development of the works." Yarrow have spent over £1 million in recent years on modernisation and development, which will enable them to compete on equal terms with most other firms.

Building Boom

There is growing evidence that the building and constructional engineering industries have reaped considerable benefits from the Government's economic measures of a year ago. The volume of new building has risen very satisfactorily, so much so that a shortage of bricks has developed in some areas. The industry's output is expected to be at least 10 per cent higher this year than last, and higher still in 1960.

The building boom has favourably affected the prospects of suppliers of plant as well as those of constructional engineers. For the plant makers the past two years have been most depressed in the home market and only firms with a good export organisation have succeeded in maintaining their turnover. The results of Broom and Wade, makers of compressors and pneumatic tools, therefore came as a surprise. Trading profits were sharply up at a new peak of £852,000 compared to £569,000 last year. Compressors and pneumatic tools are normally ordered well in advance of a major contract and Broom and Wade, who are highly competitive, have almost certainly obtained a good share of available business. On the other hand their substantial stake in local manufacturing overseas and the world-wide character of their trade was an asset while the home market was depressed.

Among the firms participating in the burst of activity of the building industry is the Boulton and Paul group of Norwich. Their activities range widely over the constructional and building fields, including the steel framing of factories, stores, schools, hospitals and other large buildings, a range of building equipment and materials such as standard joinery, scaffolding and ladders. Results for the year ended 30 September are expected to be good and prospects for the last 10 months of the current year even better.

XUM

Heliport Noises May be a Public Nuisance

Heliports are obviously a coming thing, but there is still a lot of concern about the noise nuisance that they may create. A critical review of the problem, with some quantative assessments, is made by the author.

By P. H. Parkin

Building Research Station DSIR

A lot of nonsense has been written about the noise from helicopters; for example, that they are no noisier than the traffic in Piccadilly Circus. The fact is that aircraft make far more noise than other machines. For example, the total acoustical power output of the human voice is a few thousandths of a watt while the noise output from a jet engine is measured in hundreds or even thousands of watts. A special correspondent of *The Times* once put it more intelligibly by stating that, on the average, speech will be difficult on a telephone (inside a room with open windows and nothing between the listener and the noise) when a properly silenced motor car is 10 to 20 ft away, the corresponding distance for a large propeller-driven airliner being over a mile. This article attempts to put into perspective, as far as this is possible at the present time, the noise problems that are likely when large helicopters operate regularly into city centres. When all the facts are known—the levels and frequency spectrum of the noise, the distance the noise is away, the sound insulation (if any) between the noise and the receiver—then quite reliable estimates can be made of the interference with speech or music, or the reactions of office workers (some estimate of how much the general public will be annoyed can also be made but this is a much more approximate procedure and we will not here go further into it). It is difficult to generalise because there are so many variables, but obviously in this problem of helicopter noise some attempt must be made to do so.

NOISE LEVELS OF HELICOPTERS

First let us look into the noise made by helicopters. No measurements have been published of the noise made by the larger helicopters so it is necessary to make some estimates. Furthermore, it is impossible at the present time to be precise, so the only course is to cover a range of possible noise levels. The five cases which we will consider are shown in Table I, where the decibel values are the mean of the noise levels over the whole audio frequency range, measured at a distance of 125 ft.

The frequency spectrum of the noise must also be estimated, in the absence of full data. The spectra of the piston-engined and the jet-engined helicopters are different, but this has little effect on the noise as heard. This is because the higher-frequency sounds are attenuated by the air, and windows and roofs attenuate the high frequencies more than the low frequencies. Thus, indoors, the lower frequencies predominate and in this part of the spectrum (if our estimates are correct) there is not much difference between the piston engines and the jets.

Another complication is that the noise of the helicopters will be directional, i.e., they will radiate more noise in some directions than in others. It is impossible to generalise about this, so we have assumed that they are non-directional. This means that the effects of the noise may be overestimated in some areas, but not by any great amount.

SOUND PROPAGATION AND INSULATION

It is convenient to distinguish between two directions of sound propagation in the open air. The first is when the noise source is high enough above the ground so that the line between the source and a receiver near the ground subtends an angle at the ground of greater than about 5°. Under these conditions there are only two factors governing the propagation: (i) the inverse-square law, i.e., the intensity is reduced by 6 dB for every doubling of the distance, due to the spherical spreading of the sound waves, and (ii) the absorption by the air of the higher frequencies (higher than 1,000 c/s). At least, this is known to be true for distances of up to about one mile, so for present purposes we have limited ourselves to distances between the receiver and the helicopter of up to 6,000 ft.

The second direction of propagation is when both the noise source and the receiver are on or near the ground. This type of propagation is affected by many factors including the weather, and generalisation is impossible. Further, when helicopters are running-up at the heliport there will often be obstructions, e.g., other buildings, between the noise and the receiver, and again generalisation is impossible. Thus the subsequent discussion is confined mainly to the first type of propagation, i.e., when the helicopter is high enough for the source-receiver line to subtend an angle of at least 5° (for example, when the horizontal distance is 6,000 ft then the helicopter must be at least 550 ft high).

The interference in offices due to the noise has been estimated for three classes of windows: (i) open windows, i.e. zero insulation; (ii) normal windows, closed without any special sealing; (iii) double windows fully sealed, i.e. the best practicable sound insulation for existing buildings. For auditoria, it has been assumed that there are no windows, and a rather high degree of insulation has been assumed for the roof, i.e. that of 5 in solid concrete. Of course the roofs of many existing auditoria will not have such good insulation.

Yet another generalisation that must be made is that the windows, or roofs as the case may be, can " see " the helicopter, i.e. that the windows are facing towards the helicopter and there is no other building in the way. Thus in a multi-storey area the top offices will be mainly affected. On the other hand, the roofs of auditoria will in general always be able to " see " the helicopter.

CRITERIA

The criterion used for offices is that developed in the USA by Beranek[1]; a rough check by the Building Research Station of the DSIR has shown that British reactions are of the same order. The offices dealt with in this case are what the Americans call " executive," and what we would probably call " private," as distinct from clerical or typing offices. One of the main points is that speech communication is often necessary in these offices.

Two noise levels in the offices are considered here. The first level (80 phons) represents in American terms the border between " noisy " and " very noisy "; in British terms between " noisy but acceptable " and " noisy and not acceptable." In other words this level of 80 phons represents the highest level that could

TABLE I.—*Estimated Overall Noise Levels at 125 ft*

Noise level (dB)	Type of helicopter
120	Large (40 seater) jet-engined helicopter without silencers.
110	Large jet-engined helicopter fitted with silencers of the same order of effectiveness as that claimed for present-day " fixed-wing " jet airliners.
100	Large jet-engined helicopter fitted with more effective silencers. Note that such silencers would mean either an appreciable loss of power and therefore of speed or pay-load, or a radical redesign of the engines with noise reduction as a primary aim.
110	Large (40 seater) piston-engined helicopter without silencers.
100	Large piston-engined helicopter fitted with silencers of the same order of effectiveness as those sometimes fitted to present-day small helicopters; or present-day small (5 to 10 seater) piston-engined helicopter without silencers.

TABLE II.—*Critical Distances (ft)*

Helicopter type	80 phon level in offices (ft)			70 phone level in offices (ft)			Auditoria (ft)		
	Windows:			Windows:			Class:		
	Normal (open)	Normal (closed)	Double	Normal (open)	Normal (closed)	Double	B	C	D
120 dB jet (unsilenced) ..	>6,000	1,700	250	>6,000	3,500	800	>6,000	>6,000	>6,000
110 dB jet (silenced) ..	5,500	650	<125	>6,000	1,650	300	6,000	3,750	2,250
100 dB jet (" super-silenced ")	2,100	200	<125	5,400	550	<125	2,400	1,400	750
110 dB piston-engined (unsilenced)	6,000	650	<125	>6,000	1,750	350	>6,000	4,000	2,500
100 dB piston-engined (silenced)	2,500	250	<250	5,400	600	<125	2,000	1,250	750

(The distances are limited to 6,000 ft, because of ignorance of the nature of sound propagation over greater distances)

TABLE III.—*Critical Distances for Offices*

Helicopter type	80 phon level in offices		70 phon level in offices	
	Windows:		Windows:	
	Normal (open)	Normal (closed)	Normal (open)	Normal (closed)
120 dB	>6,000 ft	1,700 ft	>6,000 ft	3,500 ft
100 dB	2,100 ft	250 ft	5,400 ft	600 ft

TABLE IV.—*Times per Flight for which Noise Exceeds Specified Levels*

Radius (ft.) from Heliport	Helicopter type	Time of 80 phon level in offices (minutes)		Time of 70 phon level in offices (minutes)	
		Windows:		Windows:	
		Normal (open)	Normal (closed)	Normal (open)	Normal (closed)
1,000	120 dB	>4	1	>4	2¼
	100 dB	1¼	0	3½	0
2,000	120 dB	>3¾	0	>3¾	2
	100 dB	¼	0	3¾	0
3,000	120 dB	>3¼	0	>3¼	1¼
	100 dB	2	0	3	0
4,000	120 dB	>3	0	>3	0
	100 dB	0	0	2¼	0
5,000	120 dB	>2	0	>2	0
	100 dB	0	0	1¼	0

ever be tolerated. The second level (70 phons) is the border, in American terms, between "moderately noisy" and "noisy"; in British terms, between "satisfactory" and "noisy but acceptable." Thus this level of 70 phons represents not unreasonable conditions in the offices, although it should be noted that it is still 10 phons louder than what the Americans call quiet conditions.

Telephoning (assuming a good line) would be "difficult" (American) or "not satisfactory" (British) with the 80 phon level, and "slightly difficult" (American) or "satisfactory" (British) with the 70 phon level.

The second criterion[2] used specifies the maximum intruding noise levels in rooms used for

Fig. 1 Increase, with time, of area in which a 70 phon noise level will exist in an office with closed windows due to a 120 dB helicopter taking off vertically.

The first point to notice is that double windows give very good protection for offices—even the 120 dB helicopter can be as close as 250 ft before producing the 80 phon level in an office, 800 ft for the 70 phon level. The quieter helicopters are unlikely ever to be close enough to cause trouble in offices with double windows. It should however be remembered that the double windows are assumed to have an 8 in air space and to be tightly sealed: this raises problems of condensation and cleaning, and of course necessitates artificial ventilation which must also be effectively sound insulated.

The second point to notice is that the distances are much the same for the 100 dB jet and the 100 dB piston-engined helicopters. Further, there is probably not much interest in the "intermediate" 110 dB helicopters. Table III is a simplified version of Table II: it omits the 110 dB helicopters, the double windows and the auditoria (which we will return to later), and does not distinguish between the jet and the piston-engined helicopters.

AREAS AFFECTED

(1) *Offices*

The distances in Table III can be used to calculate the sizes of the areas affected, and, if we assume some speeds for ascent and horizontal travel, for how long these areas will be affected.

The simplest case—which seldom happens with present-day helicopters, is vertical ascent. The maximum areas affected will be circles whose radii will be the distances given in Table III (or 99 per cent of them if we omit the initial period when the sound is at grazing incidence), and these circles shrink as the helicopters ascend. If we assume a rate of ascent of 25 ft per sec, then Table IV shows, for various radii round the heliport, the periods to the nearest ¼ minute during which the noise will exceed the specified levels for each helicopter flight.

One example of vertical ascent is illustrated in Fig. 1 which shows the variation of area with unit time, for a 120 dB helicopter and a 70 phon level in offices with closed normal windows.

What is more likely to happen is an ascent at 30° to the vertical flattening off at 3,000 ft to horizontal flight at a speed of, say, 150 m.p.h. The area affected for longer than 15 seconds for the 120 dB helicopter, 70 phons, normal window case would then be as illustrated in Fig. 2.

(2) *Auditoria*

The critical distances for auditoria have been given in Table II, and it will be seen that even for the quietest helicopter the distances are considerable. The importance of the duration of the noise will depend on the type of auditorium: it matters only little whether the business of a court is interrupted for a second or two, or for a minute or two; but any interruption—no matter how short—coming at an awkward moment in a theatre might well destroy the atmosphere for a long period.

Fig. 3 is an example: it shows the area in which class B auditoria (broadcasting studios, opera houses, theatres with more than 500 seats, and "reasonably satisfactory" concert halls) will be affected—at least momentarily—by a 110 dB helicopter taking off at 30° to the vertical and then flying horizontally at 2,000 ft.

HEIGHT OF HELIPORT

From the noise point of view, should a heliport be at ground level or at roof-top level? If a heliport is at ground level it will usually be substantially surrounded by buildings, and these buildings will act—while the helicopters are on the ground—as a screen for the remoter buildings. How much screening they will give is difficult to say, but if the buildings are several storeys high then it will be considerable. Thus only the buildings facing the site will be seriously affected by running-up noise, and Table II shows that double windows give good protection.

On the other hand, if the heliport is at roof-top level there will be little screening, and a much bigger area will be affected, although not so seriously as the buildings facing on to a ground-level site. On balance it would probably be best to have a ground-level site and to accept that double windows and some restrictions on the use will be necessary for the surrounding offices.

CONCLUSION

Many assumptions have been necessary before the above estimates could be made. However, the figures are probably not far wrong and certainly show the order of magnitude of the future noise problems. It is of course possible that the techniques of silencing may advance so rapidly that the noise may be reduced more than we have estimated. But, certainly with the larger jet engines, this does not seem very likely On the other hand, it is certainly possible that noisier helicopters might be built.

Flight paths might be adjusted for minimum disturbance, and some types of helicopter may be quieter when flying horizontally than when ascending or descending. Thus it might be better for these helicopters to fly horizontally as soon as possible. Incidentally, the noise levels assumed for the helicopters are for full power, as during ascent; during descent the noise may be a little less, but the difference will not be much because the engines still have to carry

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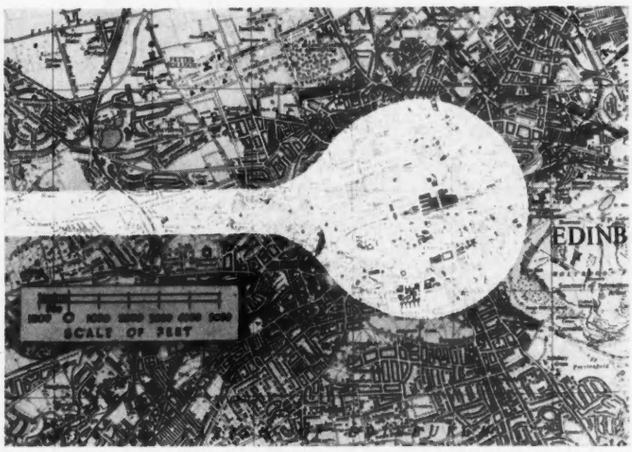


Fig. 2 Area in which 70 phon noise level exists for more than 15 sec in offices with closed windows due to a 120 dB helicopter taking off at 30° to the vertical, flattening out at 3,000 ft to a speed of 150 m.p.h.

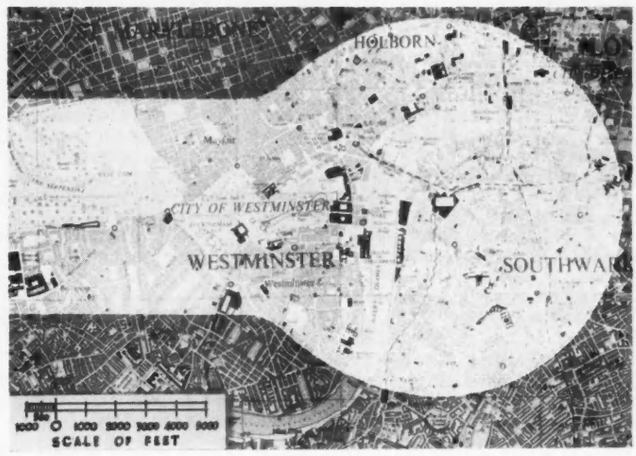


Fig. 3 Area in which "class B" auditoria will be affected by a 110 dB helicopter taking off at 30° to the vertical and then flying horizontally at 2,000 ft.

speech or music. There are several types of auditoria considered, of which we need only concern ourselves with: Class B: broadcasting studios, opera-houses, theatres with more than 500 seats, and "reasonably satisfactory" concert-halls; Class C: theatres with up to 500 seats; and Class D: cinemas, churches, and courtrooms.

CRITICAL DISTANCE

With all these generalisations and qualifications in mind, we can now estimate the distances between the helicopters and the offices or auditoria at which the specified noise levels will be reached. These distances (in feet) are shown in Table II. For example, the 110 dB jet helicopter at a distance of 650 ft will produce in an office with normal closed windows a noise level of 80 phons; at shorter distances the noise will of course be greater, and at 1,650 ft the noise will be 70 phons.

Propulsion Development for Ships

The largest controllable-pitch ship's propeller ever to be built in Great Britain has just been completed at the works of the Stone Marine Engineering Company, Charlton, London. By using the full range of its pitch control, it could effect a change from ahead to astern in the matter of 14 seconds.

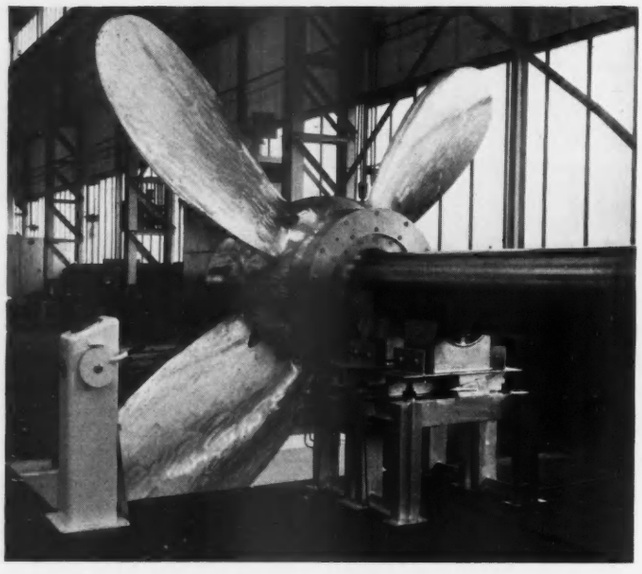
Destined for use on a 12,500 ton cargo ship, now being built at Middlesborough, the new 16 ft. diameter propeller will be fitted to a free-piston gas turbine engine which will develop some 4,000 s.h.p. at 110 r.p.m. The cost of the propeller is said to be about five times that of an ordinary type; but this is offset to some extent by its advantages, one of which is the elimination of the need for a reversing gear.

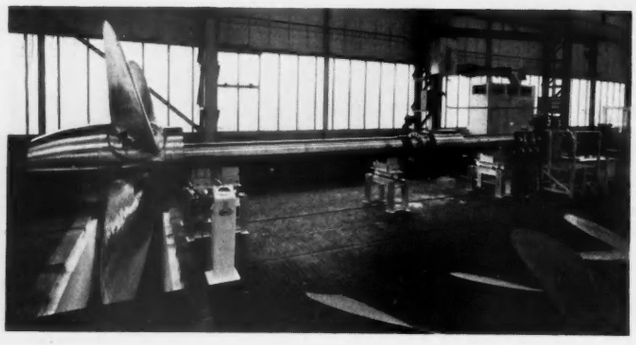
The design used is the Swedish "Kamewa," in which the blades are controlled hydraulically by a piston inside the propeller hub. This system confines to the boss mechanism all the loads required to change the pitch of the blades. Movement of the piston is controlled by valve in the hub servo motor, actuated by a tube through the hollow tailshaft. This tube also feeds oil to the valve. Oil displaced during pitch changing is returned between the tube and the bore of the tailshaft.

Inside the ship an oil distributing box, incorporating the mechanism for controlling the movement of the tube, is mounted on the shaft. This box also acts as a means of feeding pressure oil into and return oil out of the shaft to the supply tank. The tube is controlled by a servo operated fork mechanism actuating a sliding collar on the shaft, keyed to the end of the control tube through a slot in the shaft. The servo motor would normally be controlled remotely from the bridge or the engine room.

A secondary means of controlling the propeller is fitted on the oil distributing box itself, in case of any failure in the remote control system. Pressure oil to work the system is supplied by electric pumps taking their supply from a tank fitted near the distribution box, to which oil is returned after being exhausted from the shaft. The whole system is kept slightly over the external hydrostatic pressure by a header tank, so that if any small leakage occurs it will be of oil out of the system rather than sea water into it. Safety springs are fitted to the hub to bring the blades to full ahead should any failure occur in the operating mechanism.

There is no doubt that the controllable pitch propeller can offer great advantages, particularly when combined with a uni-directional propulsion system. In the case of the recently built Stone Marine propeller its adoption with a free-piston gas-turbine installation avoids the necessity for an astern turbine thus eliminating the inherent windage and heat losses.





(Left) The new Stone-Kamewa, controllable-pitch propeller has a boss diameter of 4 ft 4 in and a blade diameter of 16 ft. It is made in bronze and is designed to absorb 4,000 s.h.p. at 110 r.p.m. when fitted to a 2,500 ton cargo ship now being built at Middlesborough.

(Above) The pitch angle of the blades is controlled by an hydraulically operated piston inside the propeller hub. A single-lever remote-control unit, which could operate the propeller from the bridge of the ship, can be seen in the left foreground.

Anglo-American Team Study Northern Lights

A radio telescope has been installed at the Hillhead Experimental Station, Aberdeenshire, Scotland, to study the effects of the aurora on the propagation of radio waves. The telescope has been designed, engineered and installed by the Stanford Research Institute, California, USA, who have made similar studies in Alaska. Devising and conducting the experiments is to be a joint operation between the engineers and scientists of Stanford and the Ministry of Aviation's Royal Radar Establishment.

The research will be fundamental and aimed at a better overall understanding of the aurora and the ionosphere. It is well known that the ionised layers that comprise the ionosphere can exert a major influence on radio communications. Investigations into these phenomena are in progress at many centres. The site chosen in Northern Scotland is said to be particularly suitable for the study of radio reflections from the aurora because it is so close to the regions of maximum aura, and the geometry of the earth's magnetic field is favourable.

The radio antenna at Hillhead is a 142 ft parabolic reflector supported on an altitude-azimuth mount. It is unique in that the entire radar electronics equipment is installed in a cabin mounted on the hexagonal under-carriage of the rotating structure. The assembly rotates about a centre hub, but the weight is carried by six double-wheeled trucks rolling around a track, which consists of a flat $\frac{3}{4}$ in thick steel plate supported on a concrete foundation anchored to the bed-rock underneath.

The front surface of the parabolic reflector or dish, which forms the reflecting screen, is made of light aluminium mesh in order to reduce the wind pressure. The dish is supported by two 4 in shafts mounted in self-aligning bearings which allow the beam to scan in elevation from the horizon to the zenith.

The structure can be continuously rotated in azimuth at speeds of up to 1° per sec. The maximum speed of elevation movement is also about 1° per sec. It is not expected that the accurate positioning of the beam will deteriorate until the wind speed exceeds about 20 m.p.h. In extreme wind conditions the structure will be clamped to its foundations by six tie-rods to prevent it from overturning. The strength rating of the structure is sufficient for it to withstand winds of up to 100 m.p.h.

The antenna structure weighs 200 tons and contains over five miles of aluminium tubing. More than a third of an acre of aluminium mesh covers the face of the dish.

Concluding Heliport Noises

the weight of the helicopter.

In the areas affected—as illustrated in Figs. 1 to 3—only a percentage of office windows will "see" the helicopters, the others being screened to a greater or lesser extent by intervening buildings; the roofs of most of the auditoria will "see" the helicopters. How frequently the noise will occur obviously depends on the amount of the traffic, but with a major heliport serving directly most of the European capitals there will be an ascent or descent every few minutes: continual if not continuous.

An appendix to this paper, giving the reasoning behind the numerical values quoted above, can be obtained on application to the Building Research Station, Garston.

Acknowledgement

This work forms part of the programme of the Building Research Board, and this article is published by permission of the Director of Building Research. The maps are reproduced by permission of the Director General, Ordnance Survey.

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On the Shelf

By Frank H. Smith

To the writer and the librarian, prepared bibliographies are as useful as an electric mixer is to the housewife. They do everything but cook the food and eat it. Great purveyors of these bibliographic mixers are the Iron and Steel Institute (4 Grosvenor Gardens, London, SW1), who have just come up with Bibliographical Series No. 21a, *Bibliography on the Continuous Casting of Steel* (no relation to fly-fishing with Shackles and Rowlock) at 25*s* for non-members and 15*s* for members. The period covered is 1956-59, 14 pages, index. Each reference has a brief abstract. No. 22 in the series has also appeared, with all the glamour of a contemporary, styled cover. It looks as though an industrial designer has got at it. The subject is *Oxygen in Steelmaking* and the two prices are 37*s* 6*d* and 25*s*. This is considerably bulkier than 21a but follows the same pattern. I do wish, though, that the I and S would cut 'em down to book dimensions. I hate foolscap. It means bending down to find the shelf.

The Department of Scientific and Industrial Research have announced the names of those on the consultative committee for the National Lending Library for Science and Technology, which will start moving its stuff into Boston Spa in the first half of 1961. As is usual with these committees, it is a pretty good mixture of those whose names you would expect to find with a sprinkling of those that cause one to say " What the devil does he know about it? " On the whole, librarianship gets a pretty good showing. One hopes that the parcels division of the GPO at Boston Spa has been suitably reinforced.

A recent issue of *Soviet News* had a piece on " Standard Design for Giant Thermal Power Stations " of 2,400,000 kW. Now *there's* something for the BSI to get their teeth into. They could well charge five bob for a standard like that. Another issue of the same periodical noted that Dmitry Ilyin had designed an ornithopter that " according to theoretical calculations will be able to carry a man at a speed of up to 60 m.p.h." The Royal Aeronautical Society's man-powered flight committee need have no qualms about this though, because the comrade uses an engine and one would imagine that if he used a jet he could do even more than 60. *Our* experimenters rely on muscle power alone.

Although *Compressed Air and Hydraulics* still looks much the same on the cover, there is, over the top of its title, in smaller type but heavier, *Fluid Power Incorporating*, and on the spine all this is in type of the same size. Presumably, therefore, its short title will now be *Fluid Power*, and if anybody asks me for it under that title I shall probably have to think twice—and then not know it.

I have an announcement of a new title from the National Academy of Sciences—National Research Council (2101 Constitution Avenue, Washington 25) for *Mathematical Tables and other aids to Computation*, of which I had not hitherto heard. It is henceforth to be *Mathematics of Computation* and will continue to be quarterly at $8 a year.

Fifteen volumes, 6 million words, 62 top authorities, 8,000 articles, 8,000 illustrations, 2,000 noted specialists (where's the line between top authorities and noted specialists?) and lots more statistics add up to McGraw-Hill's *Encyclopedia of Science and Technology*. I'll let you know the price just as soon as they tell me—next year.

Ah me! I shall be quite glad when this year is over. All through it, one has seen references to what a wonderful year it was, fifty years ago (1909, that is) and when one is as old as I am, one realises that one was born in a true vintage year. And I suppose they will be saying the same things about my year in fifty years from now. But I shan't be here to appreciate it.

ON TARGET WITHOUT SIGHTS

The Bomber's Eye. By DUDLEY SAWARD. *Cassell.* (21*s*)

The part played by radar in the Battle of Britain has been widely publicised, but far less has been written and said of the tremendous contribution that radar techniques made to the Battle of Germany.

The author of *The Bomber's Eye*, Group Captain Dudley Saward, spent four years, from 1941 to 1945, at Bomber Command on the staff of that great Commander-in-Chief, now Marshal of the Royal Air Force, Sir Arthur Harris, and was responsible for the introduction of radar navigation and blind bombing into the Command. In those four years the author not only saw Bomber Command grow from weakness to massive strength, but he played a key part in the task of revolutionising the whole art and science of offensive warfare.

The Bomber's Eye is the story of how Bomber Command found itself, in late 1941, quite incapable, despite the skill and courage of its air crews, of finding and destroying the major German industrial targets. To navigate deep into enemy Europe while denied nearly all conventional visual and radio beacons, to twist and turn to evade the enemy defences, to contend with the unmeasured winds, to ignore the dummy towns and to find the target in the blackness of the smoke-laden Ruhr Valley was indeed a task. On every operation a few succeeded but many failed and the bomb loads lay scattered far and wide. Brave men died but the damage to the enemy was small indeed.

What was not then understood, but was subsequently learned, was that to inflict devastating damage by aerial attack it was necessary to produce an intense concentration of bomb tonnage in space and time. To achieve this it was necessary to be in possession of a very substantial heavy bomber force and to provide that bomber force with adequate means not only of precise navigation to the target area but of precise pin-pointing of the target for the final attack.

Lastly to carry through an offensive such as that which Bomber Command maintained from early 1942 until the end of the European war it was essential that such a force should be commanded by a man of ruthless determination, capable of maintaining the morale of his Command despite the substantial losses the enemy could and did inflict and at the same time capable of withstanding the political attacks that were ceaselessly made on the Command from other quarters.

By early 1942 the aircraft strength of Bomber Command was rising and Air Marshal Arthur Harris was appointed to its command. The Command now had the leadership that was essential for its victory. Then, from the boffins of the Telecommunications Research Establishment, came the first of the great radar navigational and bombing systems, " Gee," and by its aid the bombers could radar navigate 300 miles into enemy Europe with precision.

Then from the same backroom laboratories at Malvern came, in quick succession, " Oboe," that could drop a bomb on a target within a radius of 200 yards; H2S that could paint a map on the aircraft screen showing rivers, coasts and towns through the blackest of nights. With these new aids that were undreamed of at the beginning of the war the Commander-in-Chief could now send his forces out on their nightly missions equipped to navigate accurately in space and time and hence arrive in the target area closely spaced, and, by the aid of Oboe, H2S and GH, deliver their bomb load accurately on the centre of the target.

By this means the first great thousand bomber raid became possible, striking right at the heart of the German industry, giving a tremendous boost to the morale of the Command and silencing those who advocated the disbanding of the Command and the dispersal of its aircraft to other theatres of war.

These and other vital war-winning devices are described by Group Captain Saward in a lively and readable way that maintains the interest of all who follow the story, whether they be scientists, engineers, airmen or members of the general public. The language is direct, simple and dynamic and the spirit of those momentous days is captured with realism.

Apart from telling the story of the part radar played in the Battle of Germany the author gives a graphic and realistic picture of the unique cooperation achieved between the civilian scientist and the Royal Air Force. He also does justice to the great work of Sir Robert Renwick who played a vital part in bringing together civilians and servicemen in a sometimes explosive but cooperative union.

Group Captain Saward's employment of actual conversations could perhaps be criticised on the basis that it is most unlikely that anyone can remember so long afterwards the words employed in telephone conversations and conferences, but his technique can be accepted since it gives life to the story and reflects the spirit and atmosphere of the times. The work undoubtedly provides a most valuable historical record of a great moment in British history as seen by one man who played a vital part in it. Being one man's story it quite naturally appears at times to revolve around the man himself.

Apart from the absorbing story the book tells it is also a most valuable record written while the memory of the events is still fresh in the author's mind. It is a pity, therefore, that a number of errors should have gone unchecked, including the incorrect spelling of names that could readily have been verified, but the tale is so vital that these errors can be overlooked in relation to the work as a whole.

E. FENNESSY

STAKING AN INVENTIVE CLAIM

Patents for Engineers. By LAURENCE H. A. CARR and J. C. WOOD. *Chapman and Hall.* (18*s*)

Sir Edward Appleton, in his Reith Lectures, broadcast by the BBC a year or two ago, said: " Many people nowadays are inclined to think that, because of the rapid development of technology, the day of the inventor is over; I do not agree. . . . The world of the inventor is being invaded by the technologist; and this is a process we may expect to continue. . . . But happily, I think, there is still scope for the people who will not allow their objectives and ambitions to be influenced by the theoretical limitations of the day—people who are sceptical when they are told that something cannot be done."

All engineers, especially those engaged in spheres embracing design, research, development and application, should possess a reasonable knowledge of the subject of patents and patent law. A patent specification, however, scares most people. This may be due, in part, to its very format, with the lines of print numbered semi-decadally down each column. It may also be on account of patent agents' clear and precise language—essential for its purpose but resulting, nevertheless, in an uninspiring literary style. Could the insistence of the legal profession (and of our transatlantic cousins) in referring to " pattents " be a contributory reason for the subject usually being dubbed as " dry " ?

In this book, patents, treated in relation to engineering, as interpreted by a chartered electrical engineer who spent a lifetime resolving the perplexities of electrical phenomena,

Continued on next page

in collaboration with a barrister-at-law who is also a university lecturer, should arouse an enlivened curiosity.

The historical approach to any subject is often one which sets it in its true perspective. This work starts with the historical background of patents. It ends with a number of references to nineteenth century patents connected with steam turbines, electrical transformers, switchgear and machines. The authors claim that the development of a particular device can often be traced by reference to a series of patent specifications. The inventors' inability to appreciate fully the implications and possibilities of their inventions can, here and there, be recognised in retrospect. The history of extended developments in electrical machines, during the second half of the nineteenth century can be readily unfolded in this way while similar earlier developments in the steam-engine field are not so easy to follow. Apparently the inventors of that period were less " patent-conscious."

An outline of the British patent system deals appropriately with such aspects as the functions and responsibilities of the Patent Office; the definition of an invention, as laid down in the latest Patents Act; together with the various steps and safeguards to be taken when applying for a patent. The absolute necessity for careful and exact wording of a patent specification is rightly stressed. The authors also lay emphasis on the importance of full collaboration between the applicant and the patent agent. The advice here given to the would-be patentee on the presentation of his material is excellent and should prove most valuable. The inventor should keep in mind, when considering the patenting of his invention, that, having obtained a patent it should, firstly, cover the owner to the fullest possible extent and, secondly, it should not lead him into the danger of legal argument. This book quotes freely from legal cases which indicate the ease with which a patent can become the subject of litigation. If it serves no other purpose, it should give due warning to all concerned with patents that, if they should need to go to the courts on any of the numerous possible legal points, this can prove to be a costly and protracted business. Let would-be patentees not be intimidated too far by these timely and necessary warnings, however. Provided that the correct procedures are followed, complete information given to the Patent Agent and his advice taken, there should be little need for fear, from the point of view of legal difficulties.

As patents are, in fact, legal devices, it is not surprising to find that three of the seven chapters of this book are devoted to legal aspects of the subject. These include rights, ownership, licences, service agreements (between employer and employee), validity, infringement, together with possible courses of legal actions. The full title of the officer in charge of the British Patent Office is comptroller-general of patents, designs and trade-marks. In addition to patents the office deals with registered designs, trade-marks and copyright and the broad aspects of these kindred subjects are covered in the book.

Under the heading: " The Private Inventor," the authors contend that the majority of patents for inventions made by engineers are owned by firms. This is probably so: in 1955 published statistics indicated that, in this country and in the USA, of all patents granted only approximately 40 per cent were issued to individuals. Again, the individual inventor should not lose heart. Sealed patent specifications are their owners' passports to the commercial utilisation of their inventions. They can, therefore, be of considerable prestige value to both employer and employee in the case of joint ownership.

The patent specification is adequately dealt with in relation to the patentee, including the minor modifications imposed by the latest (1949) Patents Act. Among the provisions of this Act mentioned is that for extension of the life of a patent up to a maximum of ten years beyond its normal 16 years, in cases where it can be established that remuneration has been inadequate or that there has not been opportunity for full exploitation due to war or emergency conditions. An interesting case in this category has arisen and has been reported in the press since this book was published. In March of this year the Calico Printers' Association of Manchester had the life of their patent for the synthetic fibre Terylene extended by five years. There was objection to any extension by British Celanese (controlled by Courtaulds) but this was rejected by the comptroller of patents.

Carr and Wood have taken their material from a series of lectures given at the Manchester College of Science and Technology in 1957. The book, which is in its first edition, presents the subject matter in a coherent and logical manner. It is written in a clear and understandable but attractive style, satisfying a considerable need. Most existing books on patents (only three are quoted in the bibliography) are written primarily from the purely legal standpoint and are of limited interest to the uninitiated.

C. S. WHITELEY

The Reviewers

Group Captain E. Fennessy, C.B.E., B.Sc., M.I.E.E., is managing director of Decca Radar Limited. He has also recently joined the Board of General Precision Systems Limited, following the announcement that the two companies had agreed to cooperate in the development of air traffic control systems. Group Captain Fennessy has been concerned in the development of radar from early prewar days.

Mr. C. S. Whiteley is education officer in the English Electric Company and is an associate member of the Institution of Electrical Engineers.

Mr. F. P. Heller is senior mechanical engineer at the Sperry Gyroscope Company Limited. He obtained his degree of Dipl. Ing. at the Technical University of Berlin, and is an A.M.I.Mech.E.

NEW BOOKS

Handbuch Der Kältetechnik. Edited by R. PLANK. 7. Band: Sorptions-Kältemaschinen. By W. NIEBERGALL. *Springer-Verlag, Berlin.*

This, the seventh volume of a projected 12-volume encyclopaedic work on the technology of refrigeration, is concerned with absorption refrigerators.

The Cathode-Ray Tube and its Applications. By G. PARR and O. H. DAVIE. 3rd Edition. *Chapman and Hall.* (50*s*)

In 1937 this was first published as *The Low Voltage Cathode Ray Tube* when it meant little to anybody. Today everybody knows one application of the cathode-ray tube, but this book covers considerably more than the television image tube. Sixteen chapters with a useful reference list to each.

TRADE PUBLICATIONS

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Galvafroid. SECOMASTIC LTD., Bracknell, Berkshire. This new paint is a zinc-rich one which is applied by brush and confers protection comparable with that of hot-dip galvanising. Leaflet.

Wood Pole Preservation. BOWTHORPE ELECTRIC CO., LTD., Crawley, Sussex. The method of preserving wooden poles is safe, clean, and fast and it is low in cost. Data on materials used. 12 pages. Brochure.

Resins and Plastics. DISTILLERS PLASTICS GROUP, Devonshire House, Piccadilly, London, W1. Increasing use of synthetic resins and plastics in the chemical industry is illustrated in this 16 page booklet.

TOO STABLE FOR TOO LONG

Mechanics of the Gyroscope. By RICHARD F. DEIMEL. *Dover Publications, New York* ($1·65); and *Constable, London.* (13*s* 6*d*)

Dynamics, not practical engineering, is the subject of this book. But it was written with the needs of the engineer in mind. It avoids topics and mathematical tools outside his reach or interest, and the subject matter of the last two chapters was undoubtedly governed by engineering interest at the time the book was written. The book is an unchanged re-edition of a text that had been compiled 30 years ago, apart from a second preface in which the author expressed the opinion that it still appeared to serve its purpose. The book treats the theory of gyroscopic motion in 8 chapters and 120 pages and analyses design and behaviour of a selection of devices in two chapters and 70 pages.

As an introduction to the dynamics of rotation the book has admirable virtues. It penetrates its difficult subject with a minimum of tedium. Its mathematics is concise and to the point and as elementary as the problems treated will bear. It will undoubtedly be read with interest by many students of dynamics who will enjoy the easy but powerful attack upon the odd and bewildering antics of spinning tops and coins.

All the same, the reviewer would like to plead for a fuller verbal discussion of a host of formal results. The different physical nature of the two stable precession speeds, for example, is by no means fully presented and this difficult matter is not helped by a mathematical error in a limiting case. The reviewer would also like to see a more consistent notation and last but not least a better type, enabling the reader to distinguish Ψ and $\dot{\psi}$ without the use of a magnifying glass.

The second part of the book, devoted to gyroscopic applications, is unavoidably showing its age. Today a book about gyroscopes can hardly be imagined without any reference to the needs of aircraft and missile instrumentation but no modern instruments were known, even in principle, at the time the book was written. The book is devoted mainly to an exhaustive analysis of the Sperry marine compass and, less thoroughly, to other marine compasses, to the antiquated but impressive Schlick ship stabiliser and to various not very satisfactory designs of gyro-stabilised monorail trains. Of all these designs only the marine compass has withstood the test of time.

The chief shortcoming of the more technical part of the book is the fact that it does not introduce its readers to the fundamental engineering outlook required today. A modern analysis of gyroscopes must be solidly based upon a classification of gimbal systems and erection systems, which are the source of their correct behaviour as well as of most of their problems. But gimbal systems and erection systems, their properties and errors, which are far from elementary, have found no place at all in the book under review.

This fact, together with the absence of practically all types of gyroscopes of present technical interest make the book sadly out of date as an introduction to gyroscopic engineering.

F. P. HELLER

Treatments and Coatings for Concrete

If concrete is to encounter abrasion or chemical attack it may be wise to pursue one of the following treatments. Versatility is increased by so doing.

As a structural material, concrete needs no proving—it has already arrived. When it comes up against chemicals, however, its behaviour leaves a lot to be desired. During the setting and hardening of cement, much heat is released, and the complicated calcium compounds in it are partly transformed into simpler compounds from which the free lime is easily removed, chemically or physically; the free lime is washed out. This process weakens the resistance to other chemical influences, not only to such as acid and smokey atmospheres, but also to massive liquids when concrete is used as a container.

There are two directions from which to attack this problem, from inside, and from outside. If the reader is convinced that it is impossible to make strong, impervious and chemically resistant concrete with standard mixes, then there are many proprietory additives whose addition is said to cause improvement. Among these internal remedies can be included wetting agents, air-entraining agents, waterproofing agents, pozzolanas and other additives such as inert pore fillers. When approaching from the outside there are two courses of action: to chemically alter the surface of the concrete, aimed mainly at stabilising the free lime; or to coat the surface.

The following review covers recent developments in protection of concrete by treating it after it has set. It does not pretend to be comprehensive.

Surface treatments are used to give protection against water penetration, chemical attack or abrasion. With all the coating processes the resultant properties are those of the coating, and one must sadly conclude that none is perfect. What, however, is the choice?—the most commonly used can be summarised as follows:

(1) Silica containing media.
(2) Drying oils such as linseed oil.
(3) Various forms of bituminous or asphaltic compositions.
(4) Coatings such as epoxies and rubbers.
(5) Miscellaneous.

The miscellaneous items cover a wide range of materials, including metallic soaps such as aluminium stearate, also waxes and other organic compounds of which some are reactive and some non-reactive with the concrete.

Generally, the cost goes up as the protection becomes more perfect. A silicate wash is about the cheapest, but gives only little protection against abrasion and water penetration. At the other end of the scale, the new Viton, nitrile rubber coatings, and the better established neoprene coatings, give very high resistance to abrasion and complete protection against inorganic and many organic chemicals, but cost a great deal, and demand skilled labour for satisfactory application.

SILICA FORMING MEDIA

The silica containing media which are used include sodium silicate, magnesium silicofluoride and silicon esters. They depend for their effectiveness on the deposition of silica gel in the pores of the concrete, and to some extent upon a reaction of this silica with the lime to form calcium silicate.

When a dilute solution of sodium silicate is allowed to soak into a concrete surface, a hard glassy material is formed in the pores of the concrete. Treatment with sodium silicate has been found to be as effective as any for reducing the rate at which badly made concrete floors dust. Though not fully waterproofing the surface, such treatment does reduce the permeability, which can be made use of in concrete tanks for storing oils.

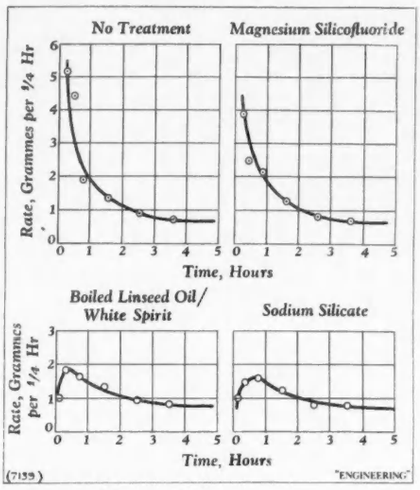


Fig. 1 Wear resistance of surface-treated concrete.

Since the process is self-clogging, care must be taken to ensure good penetration. The makers recommend that the first application should be a weak one so that it penetrates deeply. Subsequent applications should be made with progressively stronger solutions, i.e. 1 : 4 followed by 1 : 3 and finally 1 : 2 mixture of silicate and water. In the four parts of Fig. 1, the effectiveness of this treatment is compared with that of magnesium silicofluoride and boiled linseed oil. While not being noticeably better than the linseed oil treatment it is more effective (in this laboratory test) than the magnesium silicofluoride treatment and has the advantage over both in non-inflammability and non-toxicity.

Rather the same in effect is the treatment of concrete with aqueous solutions of fluorides such as straight magnesium fluoride. This reacts with free lime to yield chemically resistant calcium fluoride. In so doing, however, silicic acids are freed which gel and choke up the pores. By this "fluating" process it is not generally possible to penetrate more than half a millimetre. For light waterproofing, this superficial choking is useful, but for more complete acid resistance either the surface must be coated or else the lime must be completely removed from the concrete. It is to this end that a process called Ocrating has recently been developed.

OCRATING

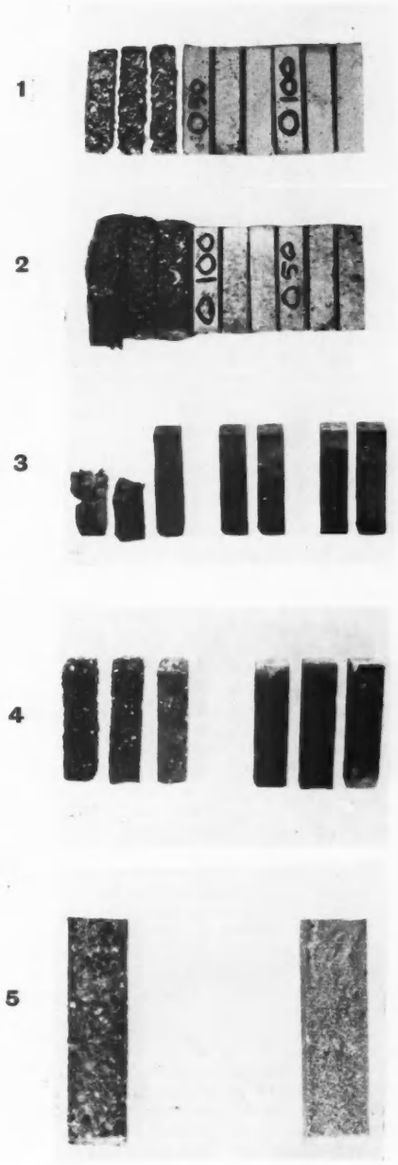
The process of Ocrating was developed by the firm of Ocrietfabriek NV in Baarn, Holland, and they have been in commercial production since 1956. Free lime in the set concrete is reacted with gaseous silicon tetrafluoride in a hermetically sealed tunnel lined with lead. The product of this reaction is calcium fluoride, and by thorough predrying the concrete with hot air, steam or infra-red heaters, choking by silicic acids is avoided. At the moment only articles which can be transported in and out of a reaction chamber can be treated. At Baarn, these chambers consist of three tunnels each 6 ft in diameter by 40 ft long which are heated and fed with silicon tetrafluoride produced by reaction of sulphuric acid with sodium fluosilicate and Kieselguhr at 60 to 70° C. A treatment cycle takes 8 to 12 hours of which 4 to 6 hours is taken up by reaction.

The product of Ocrating is a concrete which has vastly improved chemical resistance, which is stronger and has better wear resistance than a normal concrete. To put this on a firmer footing, a number of photographs are shown in Fig. 2 to illustrate the resistance of Ocrated concrete in various media including 20 per cent ammonium sulphate, lactic acid, sea water, paper mill effluent, and 20 per cent sulphuric acid.

Among the components which are at present being successfully Ocrated are sinks and washing fountains, paving tiles and piping. Ocrietfabrik hope especially to treat centrifugally-cast concrete pipes to eliminate the need for coating with bitumen, and plants for this have already been constructed. The process is used in Denmark and Germany, and the company has plants of its own in France and the Union of South Africa. So far it has come neither to the United States or the United Kingdom, although imported Ocrated sink units were shown at the Building Exhibition this year. The Dutch company say that they are cooperating with Thomas W. Ward of Sheffield, and have made a number of contacts

Fig. 2 Corrosion resistance of Ocrated concrete.

From top to bottom, Ocrated concrete to the right:
(1) 20 per cent ammonium sulphate after 4 weeks.
(2) 7·5 per cent lactic acid after 4 weeks.
(3) Seawater.
(4) Paper mill effluent after 43 weeks.
(5) 20 per cent sulphuric acid after 5 days.



with concrete works and chemical industries in this country, but these are in the confidential stage.

The attractive increase in strength of normal concrete when treated is of this order: tiles, 30 × 30 × 4·7 cm and made of vibrated Portland cement and aggregate, had a tensile flexural strength of 19,000 lb per sq. in compared with 8,400 for a " best ordinary Dutch cement " tile. Similarly in compression, the strength was 15,700 lb per sq. in compared with 8,500 for the Dutch ordinary. Although this process may seem far removed from the silicate washes just mentioned, and the rubber coatings which are just coming, the time may well come when the process can be operated on site. Certainly for treating precast units it offers a cheap method of greatly improving the properties.

SILICONE TREATMENT

Silica, silicon tetrafluoride, and now silicones. These last materials fall into the miscellaneous category mentioned in the opening paragraphs and have stearates and wax emulsions as companions. Silicones are good water repellents for the treatment of structural masonry where water pressure is not excessive, and have a number of advantages over the longer established materials. Because of their lower surface tensions they flow more readily into minute capillaries. Typical penetration is $\frac{1}{16}$ to $\frac{1}{4}$ in, depending on the porosity of the masonry. Initially silicones give a high degree of surface water repellency

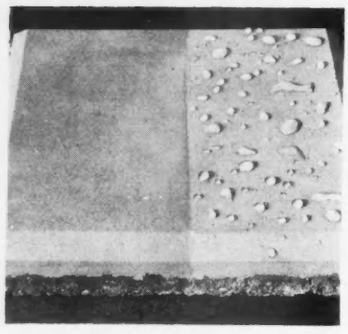


Fig. 3 Effect of silicone treatment on water repellency.

and water simply forms droplets and runs off, as is shown in Fig. 3. At this stage the contact angle of water on a correctly silicone treated surface may be as high as 110°. Absorbency tests on exposed masonry show that silicone treatment is still effective many years after the surface water repellency seems to have disappeared. Treated masonry can breathe and the coating is not visible.

Tests performed by ICI on two of their silicone water repellents are as follows, and illustrate their effectiveness. Samples of fine aggregate concrete were given a five-second total immersion dip in silicone and then allowed to air dry for 48 hours. The treated materials were then immersed face down in $\frac{1}{4}$ in of water and tested for water absorption after 24 hours and again after 168 hours. The results shown in the table are the average of six samples.

Exposure time, hr	Water absorption, per cent		
	Untreated	Treated with 2 per cent solution	Treated with 5 per cent solution
24	2·42	0·05	0·01
168	2·58	0·27	0·10

TAR EPOXY COATINGS

Bitumen coatings are straightforwardly applied to concrete by hand and are used widely for increasing the chemical resistance of concrete while making it impermeable, especially to aqueous solutions. Bitumen is, however, soluble in a wide range of organic compounds, so use with these is limited. The same holds good for tar. One of the interesting coatings produced in the last five years is the result of mixing coal tar with epoxy resins. This provides the outstanding properties of coal tar, such as water resistance, and of the epoxy resins, such as resistance to solvents and chemical attack. In addition they have excellent adhesion both to metals and to concrete. An example of its recent use was for the lining of a sump containing demineralised boiler feed water, which will ensure that there is no pick-up.

Although rather more expensive, the epoxies in the pure state are very attractive for coating concrete. They adhere well and are unaffected by the alkaline nature of the concrete, which can be the undoing of many conventional paint systems. Paints based on such resins can be formulated with high solids content so that they can be applied to the surface of porous concrete to give a smooth, tough, abrasion resistant film. It is particularly useful for protection of concrete in industrial atmospheres rich in sulphur dioxide.

Shell Chemicals make a range of resins which they call Epikote. For treating concrete, they say, an amine adduct or polyamide cured system is most generally used because of its excellent chemical resistance, although it is possible to use a resin ester top coat over an amine cured sealer coat. No elaborate surface treatment is required, but surfaces should be clean, dry, free from loose particles and oil and grease, including mould release agents.

A two or three-coat system of an amine cured epoxy resin based paint has been used successfully to coat concrete swimming pools, cold-storage room walls, concrete sewer tunnels and buildings. In Fig. 4 are shown the concrete walls of the inspection pits at the Central Railway Workshop of the Dutch National Railway at Amsterdam which are coated with such resin-based paint. The coating is cleaned every night with hot water and detergents, and this is the condition after six months from application. Out in the United States Kaiser Aluminium have recently coated the inside of a monolithic concrete stack with epoxies. This apparently cost them less than having a brick lining.

RUBBER FOR SEVERE SERVICE

Before going on to pure rubber coatings it is worth mentioning that there have been a number of coatings made by mixing resins such as epoxies with rubber. Recently Firestone Tire and Rubber in the United States announced use of their Rub-R-Road brew by the New York State Thruway Authority. This can be applied direct by squeegee, has good adhesion, and protects the concrete from salt and oil drippage.

Coating Contractors are a firm who apply the specialist high-build coatings supplied by E. and F. Richardson. Among their range of coatings which can be applied to concrete are neoprene, Hypalon, and Viton rubbers, all of which are based on materials made by Du Pont. For protection of steel structures they recognise four grades of exposure, and depending into which of these the plant falls, so the appropriate coating is chosen. So basically is the choice made for coating concrete. Good adhesion is obtained by removing all loose concrete and surface powder and treating with a 10 per cent hydrochloric acid solution. When dry, this can be followed by a primer to give good adhesion.

Self-curing neoprene maintenance coatings are called their P4 variety. They are carbon filled and are described as " self-priming one-pot protective coatings." For more severe conditions, there are reinforced and unreinforced accelerated neoprene coatings which are carbon filled and have to be used with primer. Film build-ups to 0·020 in are possible with one coat.

The unreinforced variety of the high-build neoprene has recently been employed for the lining of concrete tanks for precious metal recovery from trade effluents. The tanks were constructed of brickwork rendered with Portland cement rendering and coated internally with 0·030 in of this brush-applied coating. The tanks have, to date, been in service for over 18 months and show no signs of weakening in any way. Neoprene is suited for this purpose due to its elasticity, abrasion resistance, and very high specific resistance to a wide range of chemicals.

Once again, it has been used for the lining of six large fermentation vats in the distillery of a whisky manufacturers in Scotland. This method of construction has replaced the use of stainless steel tanks and wooden vats.

Hypalon is a chlorosulphonated polyethylene —an elastomeric material. Although the coating of a concrete roof may not appear to be a severe test for a rubber, in reality it is, for rubbers are normally very prone to ultraviolet attack. Hypalon is suitable for such applications and has been used in Porto Ricco for the protection of the concrete roof of a cathedral. One of the main reasons for using this in place of neoprene is that it can be made white, and on a roof this gives the added advantage of reflecting sunlight. Other reasons included resistance to ozone as well as ultraviolet radiation, coupled with its extensibility and its low vapour permeability. Similar applications are being considered in Britain.

Viton has only been launched as a material for coatings in recent months. This is a fluorinated elastomeric coating with a temperature resistance of up to 500° F coupled with a resistance to strongly oxidising acids and solvents. It has been used experimentally for the protection of concrete work in an electrostatic precipitator. The concrete work was suffering fairly rapid degradation due to the changeover from coal to oil firing of the boilers, with a resultant increase in the sulphate attack. A coating of 0·020 in thickness was employed in this instance, and to date it appears to be satisfactory, although the continuous service temperature is 375° F.

Assistance of the following firms in supplying information on which this article was based is gratefully acknowledged:

Coating Contractors Limited, Buckingham.
Imperial Chemical Industries Limited, Millbank, London, SW1.
Monsanto Chemicals Limited, 10-18 Victoria Street, London, SW1.
Ocrietfabriek NV, Baarn, Holland.
Shell Chemical Company Limited, 170 Piccadilly, London W1.

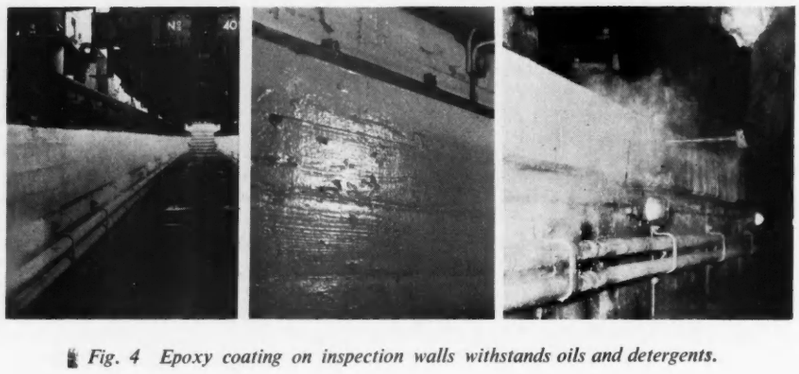


Fig. 4 Epoxy coating on inspection walls withstands oils and detergents.

Redesign Stops Connecting Rod Failures

When a component fails repeatedly in service, it is obvious that there is something radically wrong with the design. One way to locate the trouble exactly is to find the stresses in the loaded part with the aid of strain gauges and then redesign it accordingly.

One function of the stress analysis section of the British Internal Combustion Engine Research Association, Slough, Buckinghamshire, is to investigate service failures. Fig. 1 shows a connecting rod taken from a six-cylinder two-stroke engine. The open cleavage of the rod was due to the gudgeon pin forcing open the crack. The rod was one of four that had failed similarly in the same engine, but not all to the same degree. The other three rods showed the initial stages of the failure as a close crack (Fig. 2). The failures all occurred over a period of a few months, after the engine had been in service for some years. Interest in this problem was stimulated by two reports of similar failures in other makes of engine also using I-section rods.

An attempt at mathematical analysis of the stress conditions in the small-end eye did not produce useful results, because the load distribution within the end was not known (the stress system is most sensitive to this factor). Experimental investigation using strain gauges seemed to offer the best prospects for a better understanding of the failure, some possible causes of which are:

(1) Faulty material. Tests on samples of material cut from one of the failed rods showed, however, that both tensile and fatigue properties were satisfactory.
(2) Untoward happenings in the engine. The engine behaved normally up to the moment of splitting.
(3) Excessive hoop stress in the eye caused by the interference fit of the bronze bush; this is increased by differential thermal expansion.

A profile model cut from a thick steel plate, and provided with an expanding mandrel in the bore, was used to test the relative bursting stresses round the eye. Strain gauge measurements on this model showed that if bursting had been caused by excessive hoop stress, the fracture would have taken place at the top of the eye. Several of the rods, at an earlier stage of failure, showed that the cracking had started at the shank and not at the top of the eye; the fracture at the top of the rod (Fig. 1) was a consequence of the cleavage of the shank by the gudgeon pin.
(4) Gudgeon-pin loads producing forces with components perpendicular to the axis of the rod, possibly increased by stress-concentration because of the oil hole.

Fig. 1 (Right) shows the open cleavage of the connecting rod.

Fig. 2 (Below) The initial stages of failure are evidenced by the close crack.

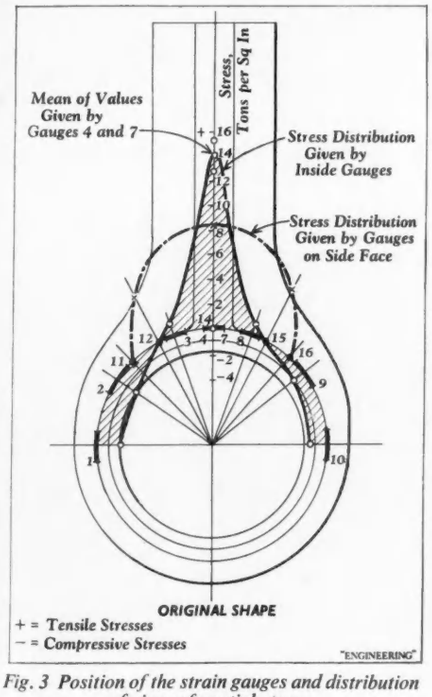

Mean of Values Given by Gauges 4 and 7
Stress, Tons per Sq In
Stress Distribution Given by Inside Gauges
Stress Distribution Given by Gauges on Side Face
ORIGINAL SHAPE
+ = Tensile Stresses
− = Compressive Stresses
"ENGINEERING"

Fig. 3 Position of the strain gauges and distribution of circumferential stress.

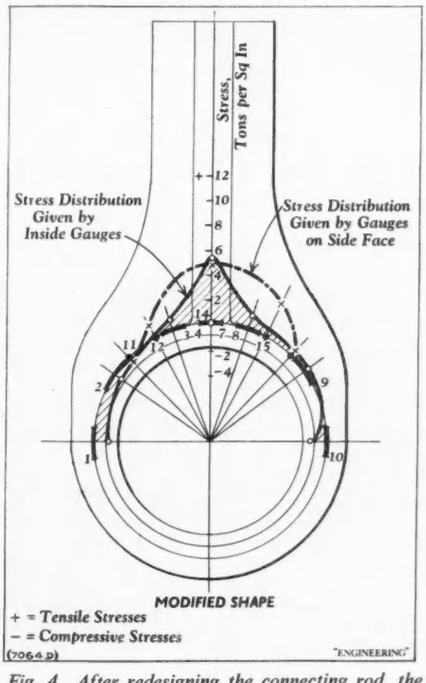


Fig. 4 After redesigning the connecting rod, the maximum value of the stress is much reduced.

A sound rod was taken and strain gauges applied circumferentially around the internal central oil groove of the eye under the bronze bush, and also where the oil hole in the shank joined this groove. This rod was assembled with its bush, gudgeon pin and piston and the whole assembly subjected to a load equivalent to that produced by the maximum gas pressure of the engine. Fig. 3 shows the position of the strain gauges and the circumferential stress distribution; the greatest stress is in the region of the split. This stress is intermittently applied during operation of the engine and must be regarded as a factor that could produce metal fatigue, especially when superimposed on any steady hoop stress produced by the interference fit of the bush. An estimate was made of the steady hoop stress and it was found that these two stresses combined were greater than the allowable stresses, as determined by tensile and fatigue tests.

After the failures had occurred, a strengthened form of small end was introduced. Fig. 4 shows how the external blending radius between the eye and the shank has been increased. The stress distribution, under the same loading conditions as before, has a much reduced maximum value. The reduced intermittent stress, in combination with the steady hoop stress, showed that the material was now working under safe conditions. In fact, no failures of this modified rod have been reported after several years in service.

Three General Purpose Strain Gauges

Details are given below of three new general purpose strain gauges offered by Tatnall Measuring Systems Company, handled in Europe by Bufra, 10 Avenue de la Grand Armee, Paris, 17e.

(1) *Temperature Compensated Rosette*

This, the first rosette gauge offered by TMS, is of the three-gauge 45° rectangular geometry that has become popular for finding the magnitude and direction of principal strains. The designation for this rosette, shown diagrammatically in Fig. 1, is 121-R3A, in which the first three digits identify respectively: advance alloy, $\frac{1}{8}$ in gauge length for all three sections, and an epoxy film carrier. The suffix R3 describes a rosette of the three-gauge type, and the letter A is the code symbol for 45° rectangular geometry with 120 ohm resistance for all sections. Temperature compensation for steel alloys, 18-8 stainless steels, aluminium or magnesium alloys is available.

(2) *Miniature 101 Series Gauge*

The 1X1-32A gauge (Fig. 2) is a new $\frac{1}{32}$ in gauge length type, for use in fillets and other areas where steep strain gradients are encountered. It is available in temperature-compensated forms. The other strain gauge is:—

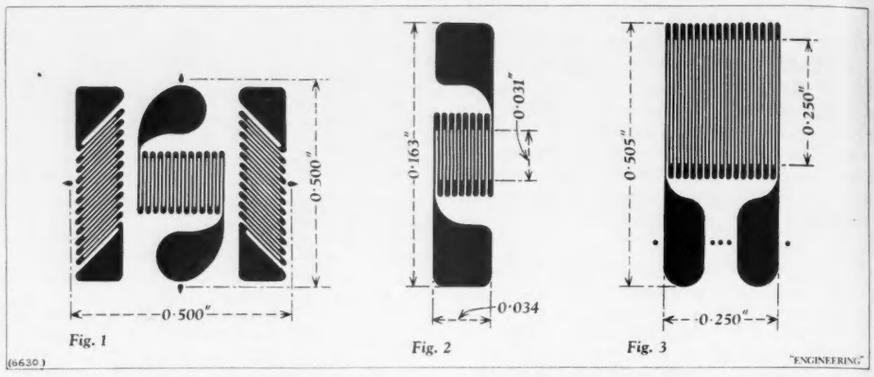


Fig. 1 Fig. 2 Fig. 3

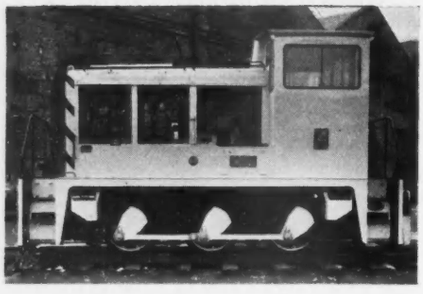
(3) *301 Series*

This epoxy-back gauge is made from an alloy of the iso-elastic type, which has long been used for dynamic work. The advantages are a high gauge factor (approximately 3·2) and a maximum endurance limit. The first one in the 301 series is the 341-500 of Fig. 3. Tests show an improvement in fatigue life up to 10 times that of an equivalent gauge in advance alloy.

These gauges are not recommended for static measurement, because of their high positive temperature coefficient. They cannot be supplied in the temperature-compensated form.

Diesel-Electric Shunting Locomotives for Export

Following the delivery of three 400 h.p. Bo-Bo diesel electric locomotives for the African Manganese Company's railway in British Guiana, Yorkshire Engine Company Limited, of Sheffield, have now completed the 230 h.p. diesel electric shunting locomotive for the same project. This locomotive is based on their standard 230 h.p. diesel electric shunting locomotive powered by a Rolls-Royce oil engine and electric transmission



and ancillaries supplied by the Traction Department of the BTH Company, of Rugby, now part of the AEI Traction Division. Many features have been incorporated, however, to obtain maximum interchangeability.

The locomotive is powered by the Rolls-Royce C8NFL engine. The generator and the two traction motors are also similar to those fitted to the Bo-Bo locomotives geared down to suit shunting duties. It is of the 0-6-0 rigid frame type with the outer axles driven by axle hung traction motors outwardly suspended. All wheels with fly cranks are connected by means of coupling rods. The traction motors drive through a double reduction gearbox.

The main frame is constructed from steel plates and steel stretchers, the frame plates being arranged outside the wheels. Dragboxes fabricated from steel plates are situated at each end of the frame and a fabricated steel stretcher extends continuously between these dragboxes. The frame is further stiffened with steel stretchers, the whole structure being designed to withstand heavy traction and buffing shocks. Buffer beams extend to within $5\frac{1}{2}$ in of the rail and provide protection for the traction motor gearcases and coupling rods.

The Rolls-Royce C8NFL diesel engine is of the vertical liquid cooled normally aspirated, four-stroke direct-injection type. The bore and stroke are $5\frac{1}{8}$ in and 6 in respectively, the swept volume 990·18 cu. in and the compression ratio 16 : 1. The traction rating at 1,800 r.p.m. is 233 h.p. gross, with 210 h.p. available for traction (input to generator). A battery-charging generator of 960 W output at 24 volts is mounted on the engine and belt driven with the radiator fan from a pulley on the free-end of the crankshaft. The belt driven air compressor is also engine mounted, with a capacity of 15 cu. ft of air per minute. The BTH flange-mounted traction generator type RTB 7426 has insulation entirely of mica, glass and asbestos of the highest grade for operation at 215 volts. The drive end of the hollow cylindrical armature spider is carried direct on the engine coupling spigot which drives on the maximum diameter of the spider to reduce torsional vibration.

Clutch Motor Controls for Rapid Starting and Stopping

Production processes where Mardrive clutch motors are used can now be made automatic, or semi-automatic, by the addition of two new controls which have been developed by the Marine Engineering Company (Stockport) Limited. The controls have already been applied to many machines in many different industries.

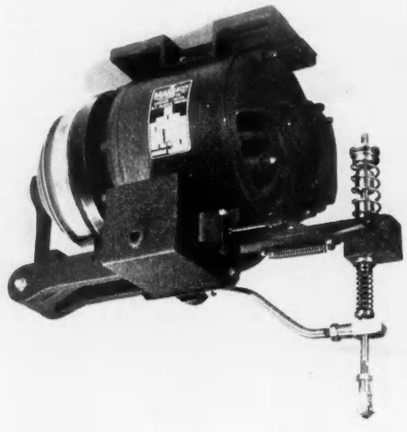
Mardrive clutch motors have been manufactured for 20 years. They are used for production processes that require rapid starting and stopping at frequent intervals, at a greater rate, in fact, than can be achieved by direct switching. Originally, the clutch motors were developed for fractional horse-powers but the range has been extended gradually up to 3 h.p. with forms of control suitable for a number of different operations.

With all these clutch motors, the heavy, dynamically-balanced flywheel is fixed positively to the rotor shaft of the motor, which runs continuously. The clutch engages with the face of the flywheel just when the drive is required. When the clutch is released, the brake comes into operation immediately so that the driven machine stops almost instantaneously.

Where compressed air is available for automatic control, an air cylinder is fitted to the clutch motor which can be controlled by a trip-valve or similar device. Alternatively, the clutch motors can be operated electrically, using a solenoid controlled by a micro-limit or time-switch, depending on the sequence of operation. By using the new controls, the driving unit can be fitted in the most convenient position for operating a machine and the problems of mechanical linkage eliminated. Remote control is possible, simply by connecting the required length of tubing or wire.

The semi-automatic control was designed originally for coil-winding and similar machines, where a gradual acceleration of the driven machine is required. The clutch is engaged gradually by hand or foot control and once the speed of the driven machine is reached, it is maintained at this speed by a spring-operated latch.

This latch is connected mechanically to a solenoid. When the solenoid is energised, it trips the latch, releases the tension on the operating lever and the brake is applied, stopping the machine. With coil winding and similar machines, a revolution counter with an electrical trip is used. By allowing for the overrun, the counter can be set most accurately.



(*Above*) *Stretch-formed Trollboat designed by Folland Aircraft and British Aluminium.*

(*Right*) *The Debutante, a 21 ft Bermudan sloop by Blanks Boatyard.*

Designed for family cruising in coastal waters, the Hawker Siddeley (Hamble) catamaran.

Capri Mk II outboard runabout just developed by Toby Marine. The finish is in durable polyester.

Racing catamaran Thai 3 by J. R. Macalpine-Downie has a 220 sq. ft Terylene sail.

35 h.p. Perkins outboard motor undergoing endurance and performance tests on a 20 ft Tuna cruiser.

One of the 36 ft 9 in glass fibre lifeboats built by W. & J. Tod for the Orient liner Oriana.

Long-Range High-Definition Radar for Sweden

The latest type of air surveillance instrument just installed at Arlanda, Stockholm's future airport, is the first of three long-range high-definition radars of advanced design that are being supplied by Decca Radar Limited, Albert Embankment, London, SE11, for use at major Swedish airports.

The radar is type DASR1, specially designed for use in areas of medium and high traffic density, where jet and turboprop aircraft are operating. At Arlanda the impressive aerial system, consisting of two separate reflectors mounted back to back, has been installed on a cylindrical tower 90 ft high, standing a quarter of a mile to the south of the airfield on a heavily wooded site. As the radar presents no technical siting problems, it is possible to get an uninterrupted, all-round view in this way, and still keep obstructions clear of the airfield. All displays and control equipment are situated in the approach control room of the main airfield control tower. The equipment is already in working order and an intensive programme of flight trials and operator training is planned between now and the opening of the airport early next year.

The DASR1 provides solid, gap-free coverage to ranges greater than 100 miles, at heights above 40,000 ft, for targets the size of a small modern airliner. The radar achieves this performance with a high degree of discrimination and can thus be used for positive control of aircraft at long range, as well as for the precise monitoring of other approach aids at close range. The installation at Arlanda is the first of its type to be completed. The wavelength of the DASR1, in the 10 cm waveband, is considerably shorter than that of radars hitherto used for surveillance by civil authorities. This is the principal factor in completely altering the operational characteristics of the radar. It makes possible a combination of long-range gap-free high and low cover, high information renewal rate (12 times per min) and improved discrimination.

The advantages of using the 10 cm wavelength have been recognised for some time, but it was impossible to use it earlier for civil air surveillance because of its susceptibility to crippling interference in rain or snow. It was only comparatively recently that the remedy (the technique of true circular polarisation) was perfected through joint research in Britain and France and these serious operational disadvantages were overcome. Preliminary trials at Arlanda show that the weather suppression system envolved jointly by Decca Radar Limited and Societé Nouveille d'Electronique of Paris is suitable for the severe conditions of the Swedish winter.

Another new feature of the equipment is the method employed to suppress ground returns that might otherwise mask echoes from aircraft. The new method is known as Air Target Indication (ATI); briefly, this is a planned exploitation of the twin beam aerial radiation pattern in conjunction with special receiver circuits. This method does not involve blind speeds, radial course limitations or the use of additional complex electronics. The performance of ATI, it is claimed, is superior to earlier systems and it is extremely stable.

The two radar displays fitted with the DASR1 at Arlanda are of the well-known Decca interscan series. Both have two main traces in order to display echoes from each of the two back-to-back aerials. They also include an accurate electronic method for measuring range and bearing between any two points by means of an electronic line, variable in length and direction. As the origin of this line can be off-centred, the course to steer (and distance to go) to any fixed point can be determined rapidly and accurately and passed to the aircraft. This electronic line may also be switched to indicate D/F bearings when required. Video mapping equipment has also been incorporated in the Arlanda installation to provide a direct picture of the airways system.

Experimental Lamp at Dungeness Lighthouse

The main revolving navigation light of Dungeness High lighthouse, on the Kent coast, has been replaced by a non-revolving flashing light of similar intensity and characteristics, but whiter colour. This is the only external evidence of an experiment that is expected eventually to result in sweeping changes in lighthouse design and a useful overseas market for manufacturers of lighthouse equipment in this country.

Trinity House Research and Development Section have a field trial station at Dungeness, and they decided to instal a Xenon lamp and equipment in the lighthouse nearby. This was done for convenience and because the experiment might affect the design of a new lighthouse that may be built to replace the existing structure, if this has to be abandoned because of the high buildings at the new Dungeness nuclear station.

The light is a Mazda 2 kW high pressure Xenon discharge lamp of a type developed by the AEI Lamp and Lighting Company, Melton Road, Leicester, for use with BTH cinema projectors. It has been housed inside a small lens on the roof of the lighthouse and is operated by experimental control equipment made by Trinity House Research and Development Section. If the experiment is a success it is likely that Stone Chance Limited, the well-known lighthouse engineers, will produce prototype equipment. The principal advantage of the new equipment is the substantial reduction in size and complexity of the optical arrangement and the reduction in power required to operate the light. Considerable simplification in lighthouse structures will result.

Many lighthouses, including Dungeness, are equipped with continuously burning paraffin vapour burners, with large revolving lenses that condense the light into beams which sweep round like the spokes of a wheel to be seen as flashes by distant observers. These lenses are formed of panels containing carefully ground glass mounted in gunmetal frames, the whole structure floating in a trough of mercury and rotated by a mechanism driven by falling weights rewound periodically by hand. Some of these lenses are of 9 ft diameter and weigh 5 ton. More recent installations have continuously-burning tungsten filament lamps and, in such cases, the revolving lenses are much smaller and are rotated by electric motors, a standby motor starting in the event of the failure of the one in service.

A small non-revolving lens is used with the new lamp because the light source is small but intense and may be flashed on and off instantaneously at a power of 2,000 W at correct intervals. Dungeness lighthouse flashes for 1·3 sec every 10 sec and the new lamp and control gear will ultimately consume only about 300 W. A continuously-burning tungsten filament lamp, providing the same light with the aid of a revolving lens, would probably consume 1 kW. The electricity supply to the equipment is by batteries which may be trickle charged from the mains, or, in isolated or off-shore lighthouses, by small diesel generators.

Trinity House has lighthouses varying in power from 100,000 to 5 million candle power. The new experimental light at Dungeness is expected to have a power of between 750,000 and 1 million candles and it is expected that a combination of circuit modification and lamp and lens design improvements will later yield 5 million c.p.

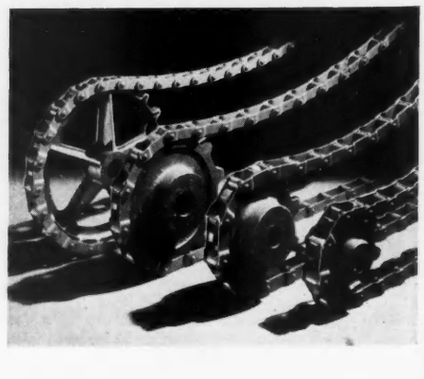
Pintle Chain with Many Uses

A new type of steel pintle chain, developed and patented by the Locke Steel Chain Company, Huntington, Indiana, has applications in a wide variety of industrial and agricultural machines and equipment.

Known as the 600 series steel pintle chain, it offers the advantages of pintle chain at cost savings which result from the patented Locke design and automatic forming and assembly methods. It is designed for industrial and agricultural applications where cost, hard operating conditions or use with cast sprockets are governing factors. It is especially useful in applications requiring a capacity greater than those of steel detachable chain, where more costly roller chain or malleable pintle chain might ordinarily be specified.

Produced in four sizes; 662, 667, 667-H and 672, to standard steel detachable chain pitches, the 600 chain is formed to close dimensions and uniform pitch from high tensile, heat treated steel. It has been tested for more than two years by leading equipment manufacturers and is now a part of several farm equipment applications.

In addition to the plain steel pintle chain, a number of attachment links are available for use in conveying applications.



Muzak Theory and Practice

Muzak is music for improving work tempo. It also has other effects. 12½ minute arrangements of popular music are played softly every half hour.

Environment affects the way a man works. Adequate lighting, pleasant-coloured surroundings, air conditioning, noise reduction, can all improve performance in office, laboratory, or workshop. But the last of these is only one aspect of the acoustic environment. Mere reduction of noise, for example, need not lead to increased productivity. A room can be made so quiet, so acoustically dead, that the atmosphere becomes sepulchral.

A recent development likely to affect the acoustic environment in Britain is the introduction by Planned Music Limited of "Muzak." It consists of the planned injection of a form of music. Certain empirical psychological rules govern the mood, timing, and length of the musical injections.

The starting point for developing a Muzak programme is the average variation of the tempo of work during a day. A section of the curve for a typical morning is shown in Fig. 1. Work tempo starts off at a high level, falls gradually to a low level at mid-morning, and then rises again as lunch time approaches. Muzak attempts to stimulate work tempo when it is at its lowest, so that a smoothing out of tempo is achieved. Ideally the variation of the stimulus intensity should vary as a curve that is the mirror image of the work tempo curve. The effect that is achieved is shown on the diagram.

It has been found that 10 to 15 minutes of music in each half hour are most effective. The music is always played softly. Stimulatory effect is assessed by Planned Music in terms of musical "mood." This they see as controlled by four components: tempo, rhythm, instrumentation, and orchestra size. For Muzak use, tempo varies from 40 to 130 metronome beats per minute; four basic rhythms are used—foxtrot, waltz, samba, quickstep; instrumentation is calculated in five categories—strings, strings - woodwind, strings - woodwind - brass, woodwind-brass, brass; orchestra size varies from 6 to 30 instruments. Thus the most stimulating music is reckoned as that emanating from a 30 piece brass band playing a quickstep at 130 beats to the minute.

Planned Music put out two main programmes: "office," and "light industry." As these two alternate in time, a third programme made up of both is available and serves as a "public area" programme, for situations where the "audience" is constantly changing. The office and light industry programmes occupy alternate 12½ minute intervals during each hour, with 2½ minute silent periods between each programme.

In making up the set of 12½ minute periods for the day's 8 hour programme, the four components are selected so that the mood of the music follows the required sequence. The usual practice is to incorporate into each 12½ minute period a trend towards a more stimulating mood. Music chosen for the programmes has to be popular with at least 85 per cent of the people who hear it.

CASE HISTORIES

In the United States, Muzak reaches the ears of 50 million people a day. The coverage is large enough for the US Defense Department to look on the Muzak system as a useful method of broadcasting civil defence alerts.

Experiments to measure the effect of Muzak on the running of business concerns have been made by Stevenson, Jordan, and Harrison, Incorporated, management engineers and consultants, New York. Case histories of three firms have been published. The technique adopted was to measure such items as output, error rate, absenteeism, time keeping, before and after the introduction of Muzak. The results obtained are significant but in the three firms studied—Prentice-Hall, Lever Brothers, Eastern Airlines—a check group of personnel not subjected to Muzak was not used, so that there was no guarantee that the improvements noted would not have occurred in the absence of Muzak Even so the statistical analysis of the results. suggests that Muzak brings definite advantages.

In the publishing house of Prentice-Hall Incorporated 24 women in a group inserting mail into envelopes were studied. The section was well lit and ventilated; the noise level was such that conversation could be carried out at normal voice level. Employees in the section were classified as unskilled clerical workers, and their job was highly routine and monotonous.

The variation in the productivity of the group of workers before and after the introduction of

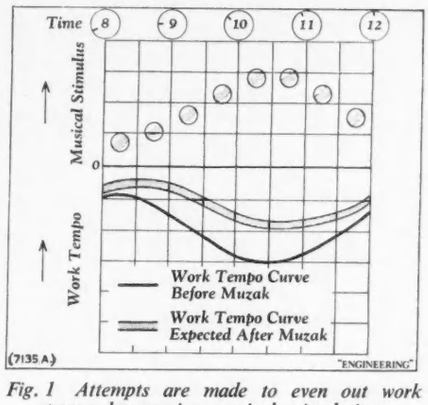


Fig. 1 Attempts are made to even out work tempo by varying musical stimulation.

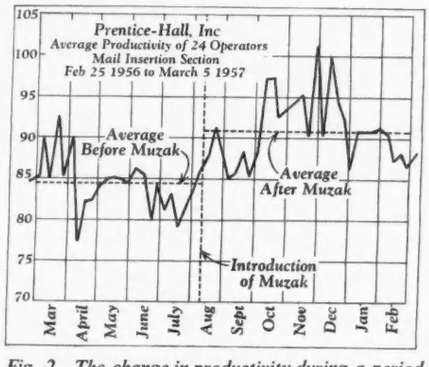


Fig. 2 The change in productivity during a period after the introduction of Muzak. The job is classified as routine and monotonous.

Muzak is shown in Fig. 2. The productivity increased from 84·3 per cent of standard to 91·07 per cent of standard—an increase of 6·77 per cent of standard, or an overall increase in productivity of 8·03 per cent. An incentive system had been installed 11 months before introduction of Muzak and may have been a contributing factor to the improvement. But employee records show that performance had already increased as as result of the incentive system, and had remained at a higher level until the introduction of Muzak. It is likely, therefore, that Muzak was the chief factor in bringing about the 8·03 per cent productivity rise.

Such an improvement in the mail insertion section alone pays the cost of Muzak for the entire direct mail operation, which employs 225 workers.

Productivity improvements were greater for the older than for the younger half of the study group. There were, however, people in the younger group whose productivity increased by considerably more than the average of the older group. Educational level did not correlate with productivity increase to any significant degree; but employees who showed high ratings in word test scores (a crude way of measuring basic intelligence) averaged 130 per cent greater productivity improvement than employees with low ratings. In manual dexterity speed scores there was no marked correlation with productibity increase; but in manual dexterity accuracy scores two employees with the highest error rates had the greatest degree of increase, although the medium level employees, as a group, showed the greatest productivity gain. No significant changes in absence records were noted after Muzak was introduced. There was a 36 per cent decrease in lateness of arrival after Muzak was installed: the figure is large enough to suggest that Muzak was a contributing factor.

CENTRAL CONTROL

The control room of Planned Music Limited, at 235 Regent Street, London, contains 3 large M8R tape playback machines. Each is fitted with 4,800 ft reels of tape. This runs at 3¾ in per second, giving an 8 hour programme. Automatic programming of the machines allows them to run continuously from Friday evening to Monday morning without attention. Controls on the panels of the machines enable adjustments to the outgoing programme—such as the insertion of Christmas carols during the normal silent periods. The control room also contains a library of 7,000 Muzak recordings—14 in 33⅓ r.p.m. transcription discs—from which complete programmes can be built up.

Nearly all the programmes for the London area originate from this room. Very occasionally—for a supermarket in an outlying suburb, for example—a tape machine is installed on the customer's premises and weekly deliveries of recordings made. When the system expands to Birmingham and Manchester, it is likely that the same London studio will control the programmes to those areas as well.

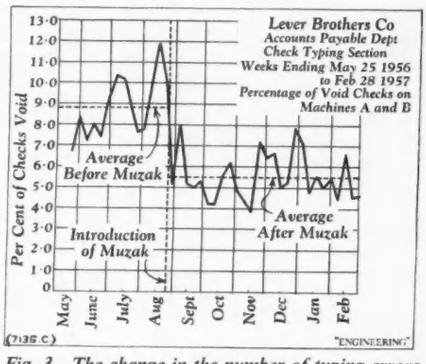


Fig. 3 The change in the number of typing errors in a typing pool after the introduction of Muzak.

Distribution of the Muzak programme is at a low level (3 dB on 1 MW) over GPO "music lines." These have a flat response curve over a bandwidth of 40 to 9,000 c/s and are balanced and equalised every 4 miles. At each block containing Muzak subscribers, distribution amplifiers are installed. A number of 12 W units are used in preference to a single high power unit; each has a bass boost of 15 dB at 50 c/s and a treble boost of 15 dB at 10,000 c/s. Thus the musical signal delivered is quite high in quality, higher than that of the average domestic radio or the usual factory installation.

Planned Music do not get a GPO line to each customer, only to each block, and the Muzak lines do not use exchange equipment. Thus the company are not in direct competition with private subscribers for telephones. But the telephone network is the limiting factor to Muzak growth in Britain—a situation which is in marked contrast to that in the United States.

Heat Treating Batches of Titanium

The greatly increased use of metallic titanium has brought with it new equipment. One of the most recent installations is an electric batch furnace at Imperial Chemical Industries' plant at Swansea.

ICI pioneered the production of metallic titanium in Great Britain using their own sodium reduction process, and they have been manufacturing it on a commercial scale since 1955. Melting plant capacity is now 2,000 tons a year, and ingots weighing one or two tons are in regular production. Their Metals Division melts the raw material and processes it into the wrought form such as plate, strip, tube and wire. The ore production takes place at Billingham and the melting at the Kynoch Works, Birmingham, while the Waunarlwydd Works at Swansea is the only plant built specifically for the rolling of titanium rod and sheet.

Titanium is the fourth most abundant structural metal and has numerous desirable properties, particularly when it is suitably alloyed. It has about 56 per cent the density of steel, while its UTS of between 22 and 55 tons per sq. in can be raised to between 70 and 85 tons per sq. in by alloying. In many applications, its corrosion resistance is superior to that of stainless steel. By reason of its unique strength/weight ratio, titanium is now well established as a structural material in the aircraft industry, and its outstanding resistance to most forms of chemical attack combined with good mechanical properties make it an ideal material for the construction of many forms of plant for the chemical, petroleum, textile and pulp making industries.

The electric batch furnace for treating titanium rod was designed and built by GWB Furnaces Limited of Dudley, Worcestershire. It is intended for the annealing, hardening and tempering of titanium rod in lengths up to 12½ ft, and from 0·4 in to 2·5 in diameter. With a rating of 150 kW in two independently controlled zones, the unit is employed for treatments within the temperature range of 800° to 1,150° C, varying according to the type of heat treatment and the charge characteristics. The equipment consists of the batch furnace itself, an overhanging charging machine, traversing rails in front of the furnace, a quench tank, a set of loading and unloading tables and the accompanying instrumentation and switchgear.

SIDE CHARGING

The batch furnace is of the side charging type, designed to give maximum support to the charge, and allow speedy charging, discharging and quenching. Its effective dimensions are 12½ ft long by 3½ ft wide and 6 in charge height. The furnace casing is of sheet mild steel suitably braced with strong rolled sections. A robust understructure supports the furnace clear of the ground and substantial cross bracings are fitted at both the top and bottom of the casing. High grade refactory bricks, backed by a layer of insulating bricks, line the heating chamber throughout. The insulated hearth is fitted with a series of firebrick piers forming grooves for accommodating the arms of the charging machine.

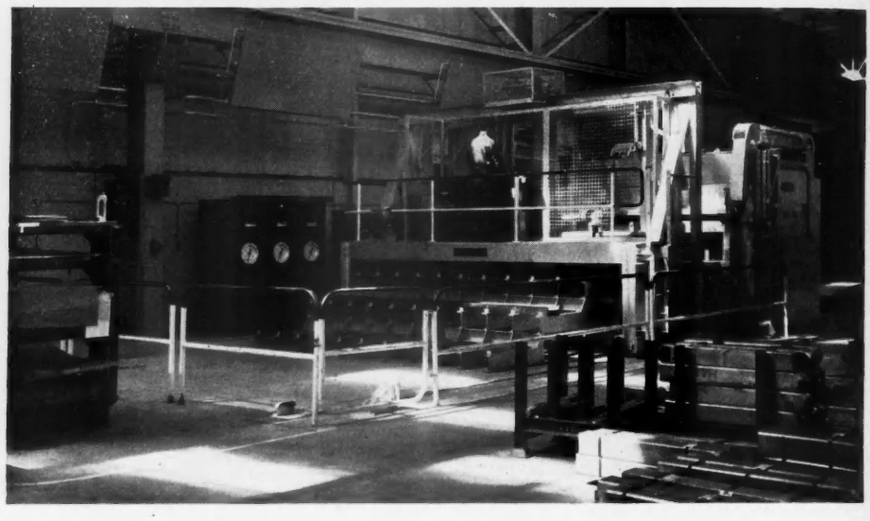
Nickel-chromium strip heating elements are arranged in the roof and hearth of the heating chamber to provide the heat. Those in the roof are supported by hook suspension system a which provides maximum support and dissipation of heat. The hearth elements are accommodated on specially shaped refactory element supports located in the hearth itself. The furnace is designed for a maximum temperature of 1,150° C. The temperature uniformity achieved in a charge covering the hearth at 1,000° C is reported to be better than ± 10° C. The furnace is also suitable for use at 700° C with a maximum variation over the hearth not exceeding ± 10° C as measured by a grid of thermocouples attached to a test framework covering the maximum charge limits of the hearth.

In designing the furnace, particular attention was paid to the vestibule which is supported by an open channel girder at the front edge throughout the entire length, the girder being heavily gusseted and fixed to the main framework of the furnace casing. A T-section of heat resisting material is suspended from the roof cross-bracings for supporting both the rear edge of the vestibule and the arch brickwork. A drop-type cast framed door, fully insulated and counterbalanced, is arranged to clamp over the furnace vestibule. The clamping device consists of a metal buffer bar running across the outer face of the door and attached at either end to the furnace casing. The inner face of the buffer is fitted with wedge shaped metal sections at intervals along its length which marry up with similar wedges fitted to the outer face of the door, when the latter is in the closed position. The door driving gear consists of an electric motor transmitting through the necessary reduction and spur wheel gear to mainshaft driving chains fitted to lugs on the door.

In order that the quench can be carried out quickly, the quenching tank is situated immediately in front of the furnace just below hearth level. It is a plain bosh-type tank measuring approximately 15 ft long by 3 ft wide and 2½ft deep.

A charging machine, traversing on a set of rails is constructed to move over a set of loading tables and the quench tank in order to insert the charge into the furnace hearth. A series of fixed horizontal arms, which support the charge, are arranged for insertion between the firebrick piers in the furnace hearth. When the charge is resting on the arms and is positioned over the quench tank ready for quenching, this part of the machine is lowered. The vertical uprights to which the charging arms are attached are fitted with rollers riding against the fixed uprights of the machine structure. This vertical operation of the charge arm structure is effected by means of an electric motor through reduction gearing.

Instrumentation and switchgear are contained within two separate cubicles. The GWB switchgear panel contains the contactors for the furnace zones, door drive motors, etc., and the other panel houses the necessary temperature control equipment. In addition, adequate provision is made for the protection of the operator, charge and the equipment itself.



Loading titanium rods into the furnace. The charging tables are visible beneath the overhanging charging machine and titanium billets are stacked in the foreground.

Sifting, Blending and Packing Tea

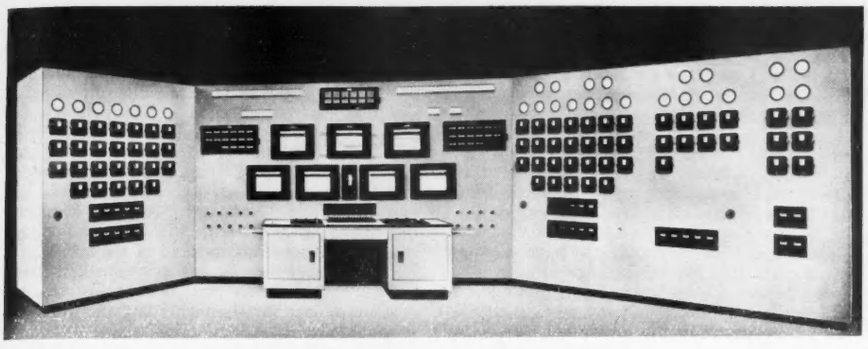
New equipment installed at the factory of David Greig Limited, London, SE1, has allowed a tea packing and blending plant to be replanned within a much smaller floor area. A screw conveyor has made it possible to carry out the tea processing on two floors of a building. It is reported that this is the first time that this has been possible in Britain, as previously the sifting, cutting and blending of tea has been carried out on two floors of a building, with the packing being done on a lower floor, thus occupying three floors in all, gravity carrying tea from one operation to the next. The new method marks a considerable improvement.

Unblended tea arrives at the warehouse from the docks in chests. It is loaded into a sifting and cutting machine. The machine is mounted on rubber shock absorbers to prevent vibration, and can be adjusted to either sift and cut the tea or merely to sift it, depending upon the type of tea being processed and the ultimate blend which is desired. After processing, the tea falls through into a specially designed hopper which projects through the ceiling of the floor below. Into the base of the hopper is fitted a Mayrath conveyor which lifts the tea by means of an Archimedian screw up to the blending machine where the tea is mixed thoroughly and any dust is extracted. This machine used to be on the floor below the sifting and cutting machine and was fed by gravity. The action of the screw conveyor enables it to be installed only a few feet away from the sifter and cutter and on the same floor. Electromagnets inside the blending machine and at the outlet chute extract any metal particles which might be in the tea. From the chute the tea is conveyed along a moving belt into a hopper, and then to a packaging machine on the floor below.

The new method of handling tea has greatly reduced the amount of manual handling involved and made possible a reduction in labour costs. A further saving will be made when a hydraulic lift truck is used to bring the tea chests up to the sifter and cutter and tip them automatically.

Production

Controlling an Oil Refinery



The control desk of the Dinslaken oil refinery.

It is claimed that the first application in the world of electronic process control equipment to an oil refinery was the sulphur dioxide extraction plant at Llandarcy, South Wales, in 1951. Subsequent years have seen so many further applications for electronic control in the petrochemical industry that the technique has now become an accepted and essential feature of modern process engineering. The latest development is a large control panel and desk made by Evershed and Vignoles Limited for installation at the Dinslaken oil refinery of the BP Benzin und Petroleum AG in Germany, constructed by the Kellogg International Corporation.

The control desk for Dinslaken contains the process controllers, indicating and recording facilities, supervisory instruments, and manual control provisions for two crude distillation plants, a hydrofiner, a catalytic reformer, and a redistillation unit. Thus it accommodates within a remarkably small space every one of the 120 separate control loops which are required for the operation of the refinery.

To conform with modern practice, particular care has been taken to reduce the number of supervisory personnel required for day-to-day operation of the plant. The extensive use of "in-line scanners" greatly facilitates this. During satisfactory operation of the refinery, an unbroken shadow line is presented to the operator, and any break in this line imediately pin-points the part of the refinery where a deviation from desired conditions has occurred; it also gives an indication of the magnitude and direction of this deviation.

An unusual feature of the control panel is the provision of two recorders for each panel—apart from the recorders employed for standard temperature measurements—each permitting the recording of plant parameters from 16 different points distributed widely throughout the refinery through a simple plug-in selection system. With this arrangement, it has been possible to provide in a most concentrated form the comprehensive instrumentation and recording facilities required during start-up and for similar occasions, occupying only a minimum of panel space. The plug-in recording facilities have been made possible because the electronic repeater measurement system automatically compensates for any additional display or recording instruments which may be temporarily inserted into the measurement circuit, without affecting the accuracy of the system.

Spray Finishing Without Clogging

A problem frequently met in spray finishing is that of feeding heavily pigmented material which readily settles out when the spray gun is not in use. Manufacturers who spray filler as part of the finishing process know the difficulties which can be encountered after work has been interrupted for only a few minutes. The material, after leaving the pressure container, may settle out in the hose, and spraying cannot be resumed without there being a considerable waste of time and filler.

Alfred Bullows and Sons Limited of Walsall, Staffordshire, having encountered this problem in their own production, have solved it, and offer to others their simple solution. The Bullows Pogo pump is used to feed the material through a standard fluid hose to the spray gun, to which is attached a Y piece. From the Y piece a second piece of hose provides a return flow to the pump and hence to the container of the material, which is itself kept agitated by this constant flow and return of material. This arrangement is reported to have been running for just over 18 months, day and night, and it is possible to pick up the gun and spray at any time without any stoppage at all. The Pogo pump will pump from a mixing or storage tank, or can even be mounted on the existing pressure feed container. The equipment operates off the existing air line, using about

3 cu. ft per min of air at pressures down to 30 lb per sq. ft.

It is reasonable to suppose that this development will find an application in the machine tool industry and similar trades where finishing of castings is carried out on a large scale. Since many machine tool finishers use metallic paint, the same pump can be used to overcome their paint's tendency to settle out.

Marketing

Stoke Orchard Smokeless

The major impact of the Clean Air Act on demand for smokeless fuel should be felt from 1965 on. The National Coal Board's investment in plant to provide suitable smokeless solid fuels will be at least £10 million and may be £20 million.

Dr. J. Bronowski, director-general of the NCB's process development department, giving this information at the recent Coal Industry Society lunch, explained that in four years there had been a 70 per cent rise in the sale of premium smokeless solid fuels. This is a greater rise than in the sale of household oil.

The basic requirements for the new solid fuels was that they should be convenient to handle and store, should ignite easily, burn brightly and long, and pick up well when the fire is made up. Finally, they must leave only a little, non-dirt creating ash.

This may sound an impossible specification but Dr. Bronowski said that NCB scientists have produced such fuels at Stoke Orchard, near Cheltenham, and produced them from coal of a kind now abundantly available. Pilot plants are now being built as the next step towards commercial scale production.

Orders for Scotland

The Port of London Authority have ordered a £1 million dredger from the Paisley firm of Fleming and Ferguson. When complete, with engines also made by the Paisley company, the dredger will be the largest at work in the Thames. With a dredger now being built for Calcutta, Fleming and Ferguson have more than a year's work for their yard.

A complete ten-unit synthetic rubber plant costing £500,000, has been ordered by Soviet trade officials for assembly in Siberia from John Dalglish, of Thornliebank and Pollokshaws, Glasgow. This is not Dalglish's first venture abroad. They have staff putting up a seven-unit plant in Japan just now.

New Cars for Old

Vehicle Contracts, who claim to be the biggest contract hire organisation in Britain, are offering to buy the vehicle fleets of operators if they become clients of their hire service.

One of the attractive factors behind the rapid growth of car hire by the fleet, instead of company's maintaining their own vehicles, has been the cash question. Hiring a fleet of cars for the first month's rental down has been a help to the smaller firm, for whom notoriously the most difficult problem is often that of raising capital.

Passing off depreciation worries to the contract organisation is another gain. The rapid replacement facilities after breakdown or accident of a large hirer are also beyond th scope of all but the largest company. Even for the large company to maintain such a ratio of cars to its car-entitled staff as to equal the service of a contract organisation would be uneconomic.

New Northern Earth-moving depot

Two of the largest makers of earthmoving equipment, Allis-Chalmers and Fiat, are to provide improved service in the north of England. Their distributors, Mackay Industrial Equipment, have established a new depot at Wheatley Hall Road, Doncaster, following the opening of a new spare parts and facilities building at Feltham, Middlesex.

Medical Equipment for Russia

The Soviet Union has placed an order with Mullard Equipment Limited for a 4 million volt linear accelerator designed for X-ray treatment of deep-seated tumours, which will be installed in Moscow.

The machine will be similar in design to those built by the company for hospitals in the United Kingdom, but will incorporate a number of technical improvements. These will give it a larger X-ray field for a given output, reduce the time needed to set up for treatment, and confer greater flexibility in control. The present order, valued at over £50,000, represents the tenth linear accelerator to be built by Mullard. Of the previous machines four were for medical use, one for industrial radiography and four for scientific research purposes.

New Project for Smith

A new type of impeller is to be made and marketed by S. Smith & Sons (England), as a result of a licence agreement concluded with the Torrington Manufacturing Company, of Torrington, Connecticut, USA. Smith's have formed a new department, the Air Impeller Department, which will manufacture and market a range of air impellers throughout the world except the American continent.

The department will provide fans for a wide variety of industrial and domestic uses, ranging from air conditioners, refrigerators and electronic cooking equipment to house warming units.

St. Erik's Fair

The success of St. Erik's Fair held in Stockholm earlier this year is described in a report published by the Fair authorities. The most notable development was an increase in the importance of the special section which the report states "provided the heavier industries with a better sales support than formerly." The public was admitted to the general section only, which was divided into clearly defined commodity groups. Those who attended the special section were, therefore, able to establish contact with exhibitors in a quieter atmosphere.

Although the Fair was held for only 12 days (against 16 in previous years) attendance was higher. In all, 304,400 were admitted, including 105,900 trade buyers, some two-thirds of whom attended the special section of the fair. The special section included a wide range of engineering products as well as exhibits from the mining, forestry and agricultural industries.

At Home

Watches to Last

Although ubiquitous, the wrist watch remains one of the most accurate pieces of equipment made. It is also one of the most reliable. Watches can be mass produced at remarkably small cost and yet the timekeeping is maintained to an accuracy of seconds per week—and 10 seconds per week is an error of only 1 in 60,480. Even an error of a minute per week is only 1 in 10,080. When it is remembered that the balance wheel makes four swings for each second, then the regularity of its motion becomes quite frightening.

The ordinary wrist watch can have anything between 50 and 100 pinions, cogwheels, pins, screws, levers, barrels, springs, pawls, and ratchet wheels. The smallest screws used may well be smaller than the proverbial pin's head, and even the larger ones will run at 10,000 to the pound avoirdupois. Inevitably, some handling is involved during assembly and with the best will in the world sweat from the fingers is left on the parts. Sometimes this is sufficiently acid to cause corrosion—and there does not have to be much corrosion to cause damage to parts of this size. But, since 1951, a method of plating has been developed that both combats corrosion and reduces the friction on moving parts.

In that year the Tin Research Institute developed a method of electroplating an alloy of nickel and tin in the ratio of 35 to 65. It was found that the deposit differed in properties from either of the constituents. It was outstanding in its resistance to many chemical and corroding agents; it was nearly as hard as chromium and so had excellent resistance to scratching and abrasion; and it had a low coefficient of friction. In addition, it could be deposited uniformly in relatively thick coatings and its "throwing" power was such that it would penetrate into such small spaces as between the teeth of a watch gearwheel and even into the bearing holes.

Several makes of watch are now on the market in which all the interior parts are tin-nickel plated. The thickness can be closely controlled and for the larger parts is usually 0·0003 in while, for the smallest screws, it may be as little as 0·00003 in. Even at this thickness, worthwhile protection is given to the parts and the low friction is an advantage. As the plating can be applied equally well to steel, copper, and brass, a uniform internal finish is obtained which enhances the appearance of the mechanism. The deposits are semi-bright but will give a true bright finish if the parts are first polished. Polishing the plating gives a brilliant finish as the deposit is very fine grained.

Since all the parts of a watch are so small, it follows that the plating equipment required is not bulky. The Tin Research Institute say that a selection of barrels ranging from a few cubic centimetres up to a litre will suffice for most of the work, but that a five litre barrel might be preferable for plating watch cases and frames.

Tin-nickel is not an expensive finish. The costs are directly comparable to those of nickel-chromium finishing, with the added advantage that the tin-nickel is deposited in a single plating bath (and therefore in one operation), whereas two separate baths are needed for nickel-chromium, one for the nickel and the other the chromium.

The tin-nickel is applied to all the interior parts of the watch so that surfaces that bear on, or engage with, each other are protected from wear. In addition, the deposit has the property of retaining films of lubricating oil for a very long time without being corroded by them. Thus full advantage can be gained from a trace of oil and the watch will work for long periods without risk of deterioration or the need for re-oiling.

The electroplating also protects the interiors from corrosion due to condensation. Few watches are completely watertight, let alone air-tight, and changes in temperature, such as occur when the watch is taken off the wrist and placed on a cold shelf, can cause condensation in the watch as temperature changes always do for other objects. The protection against the entry of water, so common a trouble on the summer beach, is similarly improved.

As regards appearance, it has already been mentioned that the plating can be applied to copper, brass, or steel, to give a uniform finish. The final deposit has a distinctive pinkish colour which blends very well with stainless steel. The coloration makes it easily distinguishable from other plated finishes such as silver or chromium, and also from aluminium and its alloys. It is possible, therefore, to make either the bezel or the watch case from stainless steel while the other is tin-nickel plated without there being any noticeable colour contrast. Dorages Huguenin of Switzerland have been using tin-nickel plating for upwards of three years and the finish is regularly used in several makes of Swiss watches. In Scotland, Timex have also been using the process. The use of tin-nickel has also been extended to drawing instruments, preventing them from tarnishing in use.

END OF THE 188th VOLUME

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Go-devil

Exorcising the powers of darkness or building rolling mills, both make considerable demands on vocabulary. Some of the most picturesque phraseology used by mill designers is to be found round the areas of a plant where rolled steel is assembled, transferred and cooled. This is a world of rocking beds, dragon teeth, ducking dogs and—yes, even go-devils.

The go-devil pushes hot rolled stock from the run-out table on to the cooling bank. It is one of the many auxiliary units helping to keep steel output flowing shift after shift, units which have to be as carefully designed and as strongly made, as any other in the production chain.

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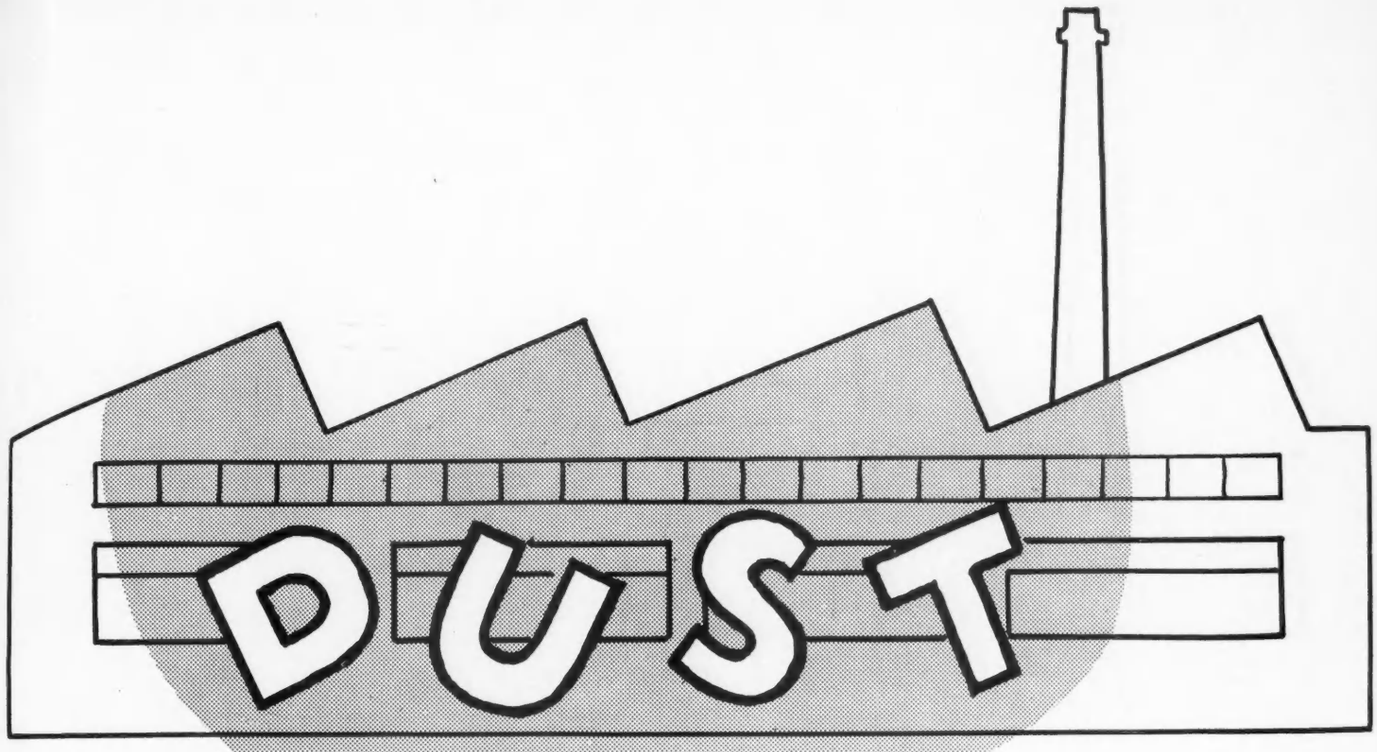

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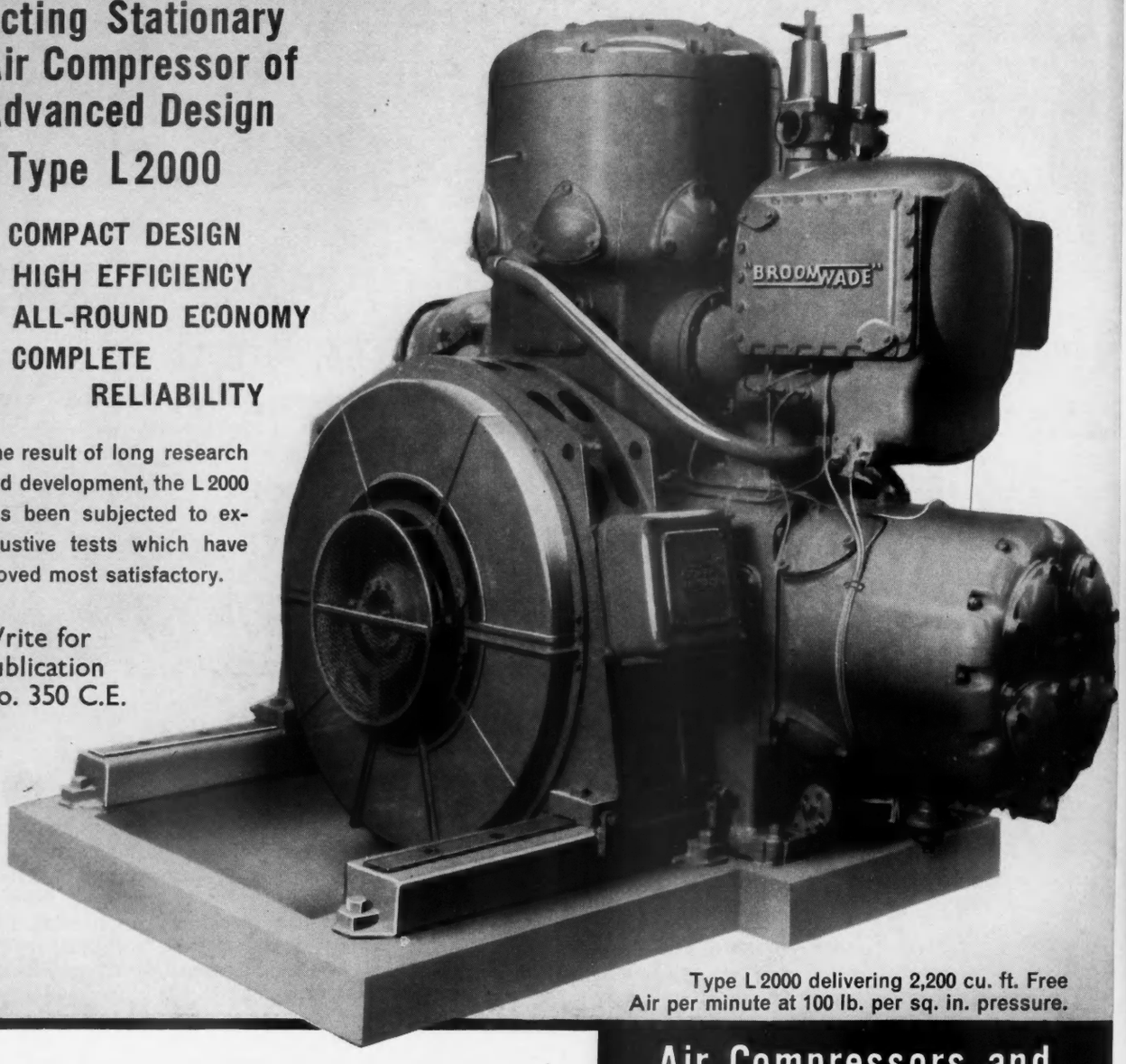

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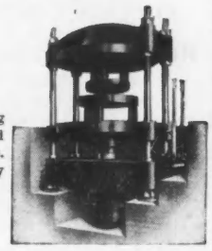

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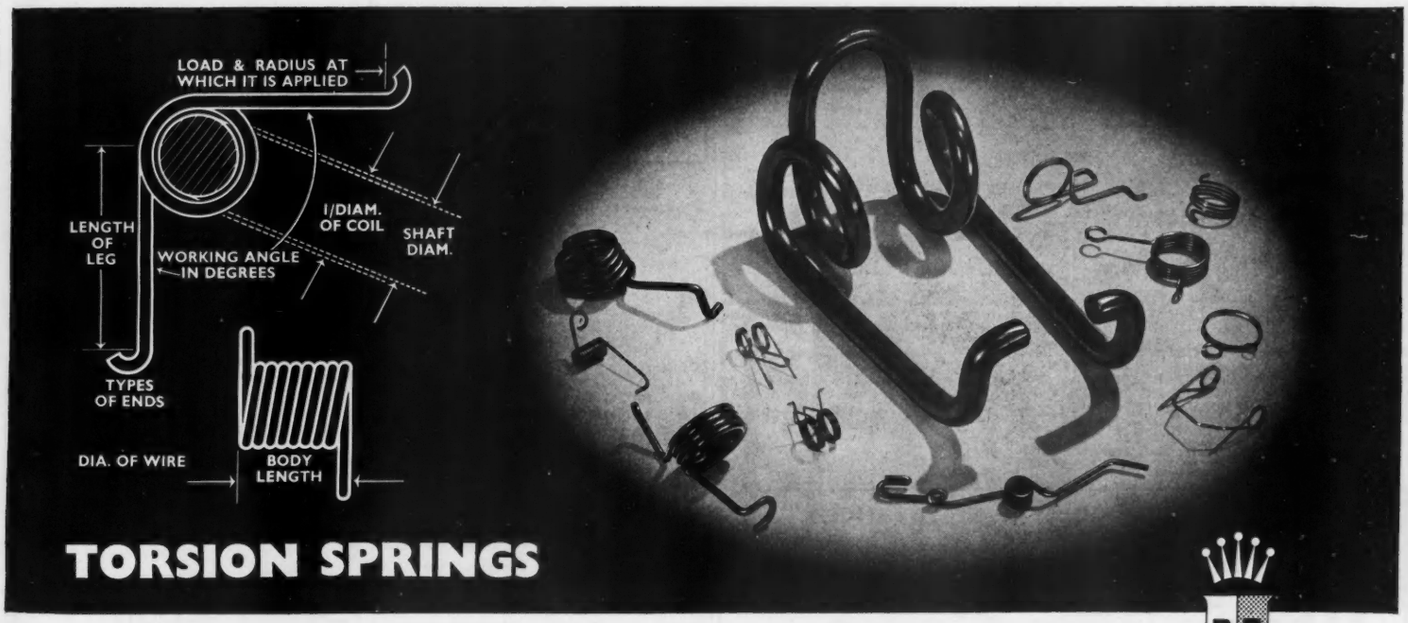

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Trade and Technical

TENDERS

REQUEST FOR TENDERS FOR TROMBAY FERTILISER PROJECT-EXTENSION OF DUE DATE

With reference to the advertisement which appeared in the local Press on September 4, 1959, calling for tenders for the above Project. The due date has been extended from 31st December, 1959, to 29th February, 1960. Ref. 83484/59/NSC/ENGZ. A 918

MUDI RIVER WATER BOARD, NYASALAND

NOTICE TO CONTRACTORS

TENDERS are invited from manufacturers for the supply and delivery of **VALVES AND WATERWORKS FITTINGS** in the MUNICIPALITY OF BLANTYRE AND LIMBE, NYASALAND for CONTRACT NO. 2 of the WALKER'S FERRY SCHEME.

The Contract includes for the supply of:—

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Tender documents in triplicate may be obtained from the CONSULTING ENGINEERS, MESSRS. SCOTT & WILSON, KIRKPATRICK & PARTNERS, P.O. BOX 154, BLANTYRE, NYASALAND, or 47, VICTORIA STREET, LONDON, S.W.1, ENGLAND, during December, 1959, on payment of a deposit of ten pounds sterling in the form of a Banker's draft only, in favour of the Mudi River Water Board. This amount will be refunded on receipt of a *bona fide* tender or the return of all contract documents.

A period of approximately six weeks will be allowed for tendering after the date on which the documents are issued. Tenders in sealed packages shall be endorsed and delivered in the manner and on the date stated in the instructions contained in the documents.

The Mudi River Water Board does not bind itself to accept the lowest or any tender.

ALEXANDER MILLAR, A.M.I.C.E., M.I.Mun.E., M.I.W.E.,
ENGINEER MANAGER,
MUDI RIVER WATER BOARD,
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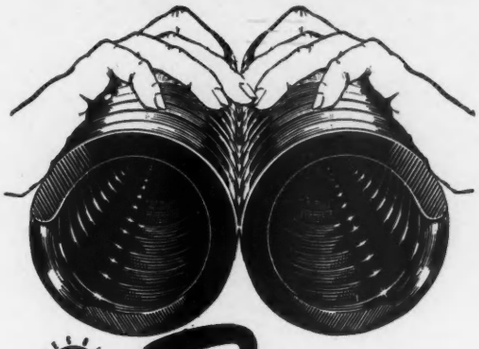

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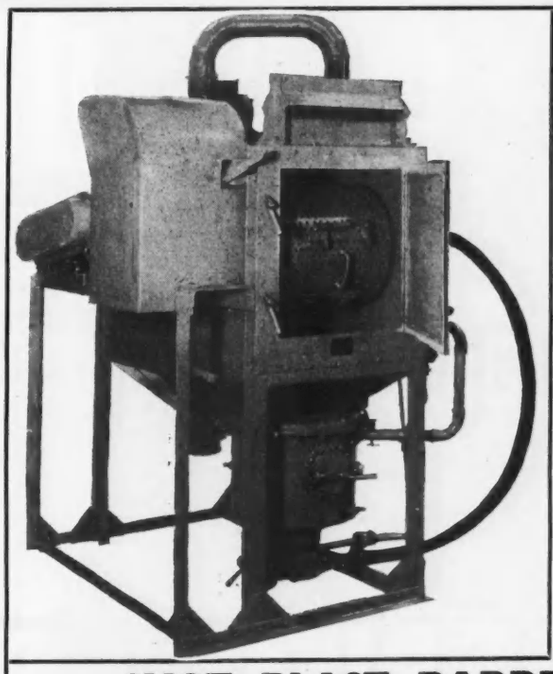

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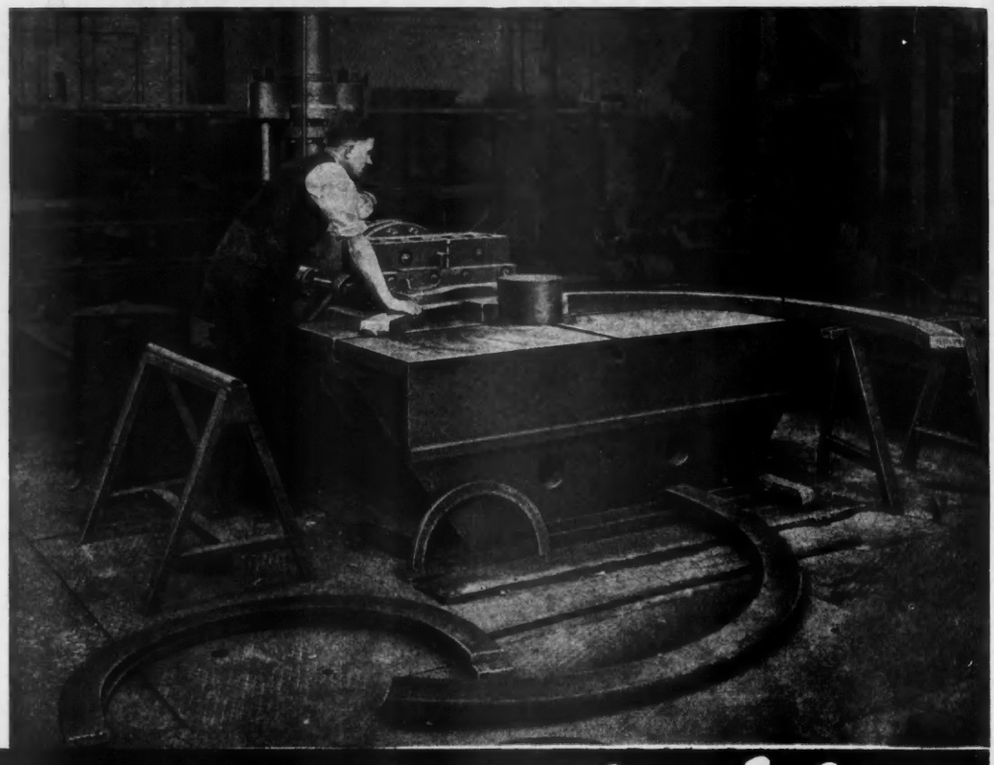

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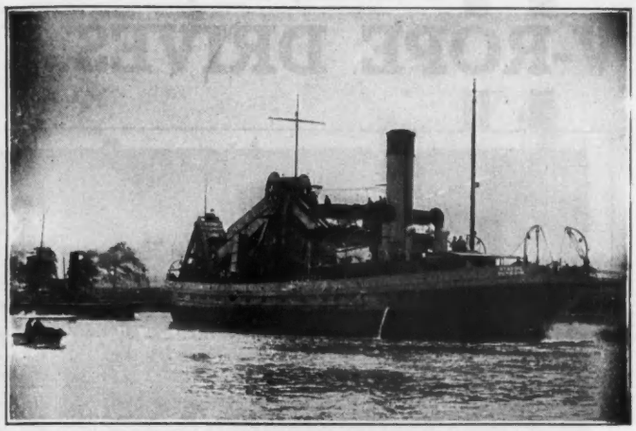

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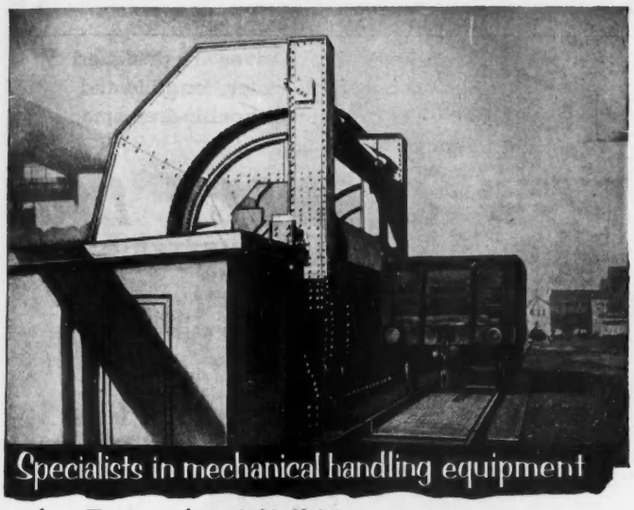

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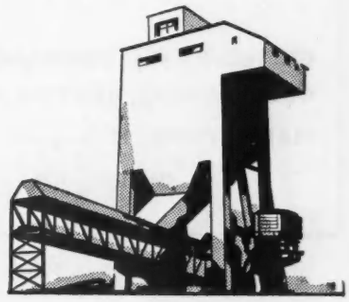

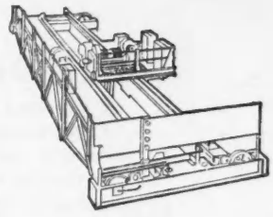

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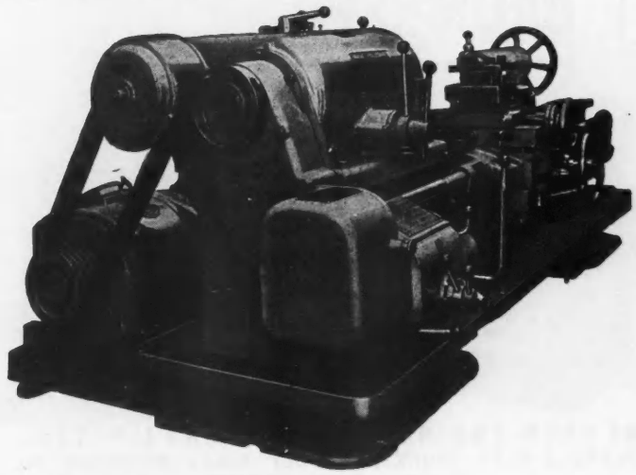

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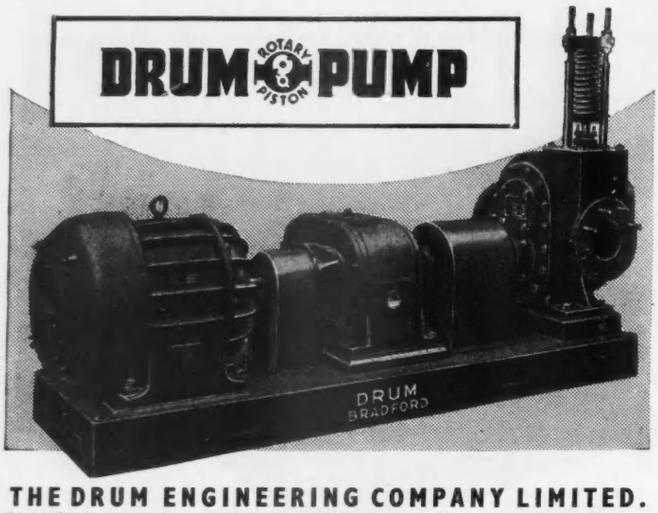

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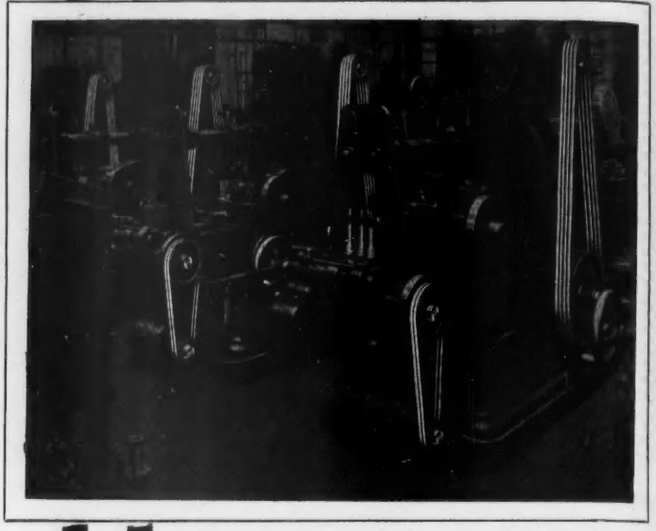

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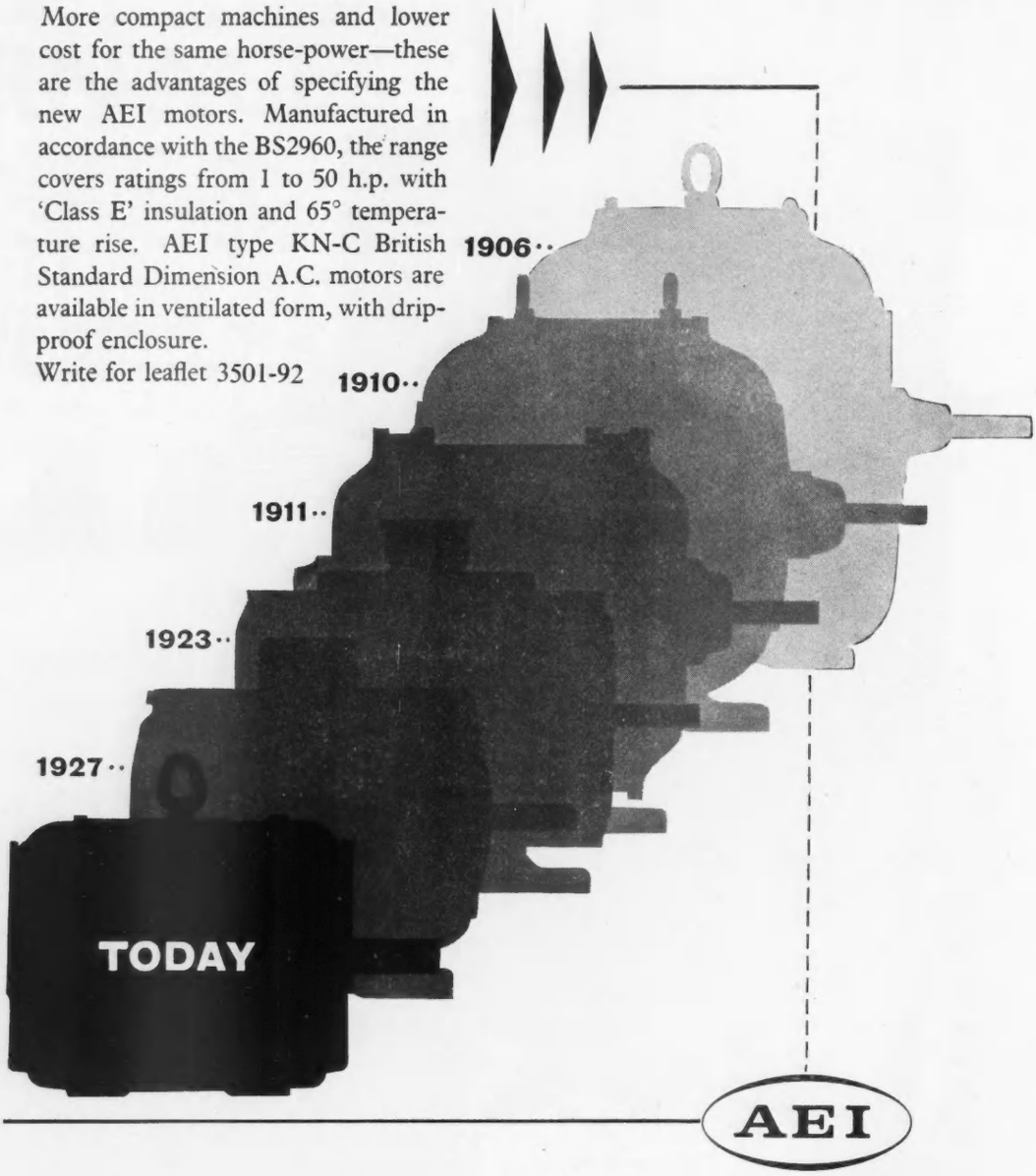

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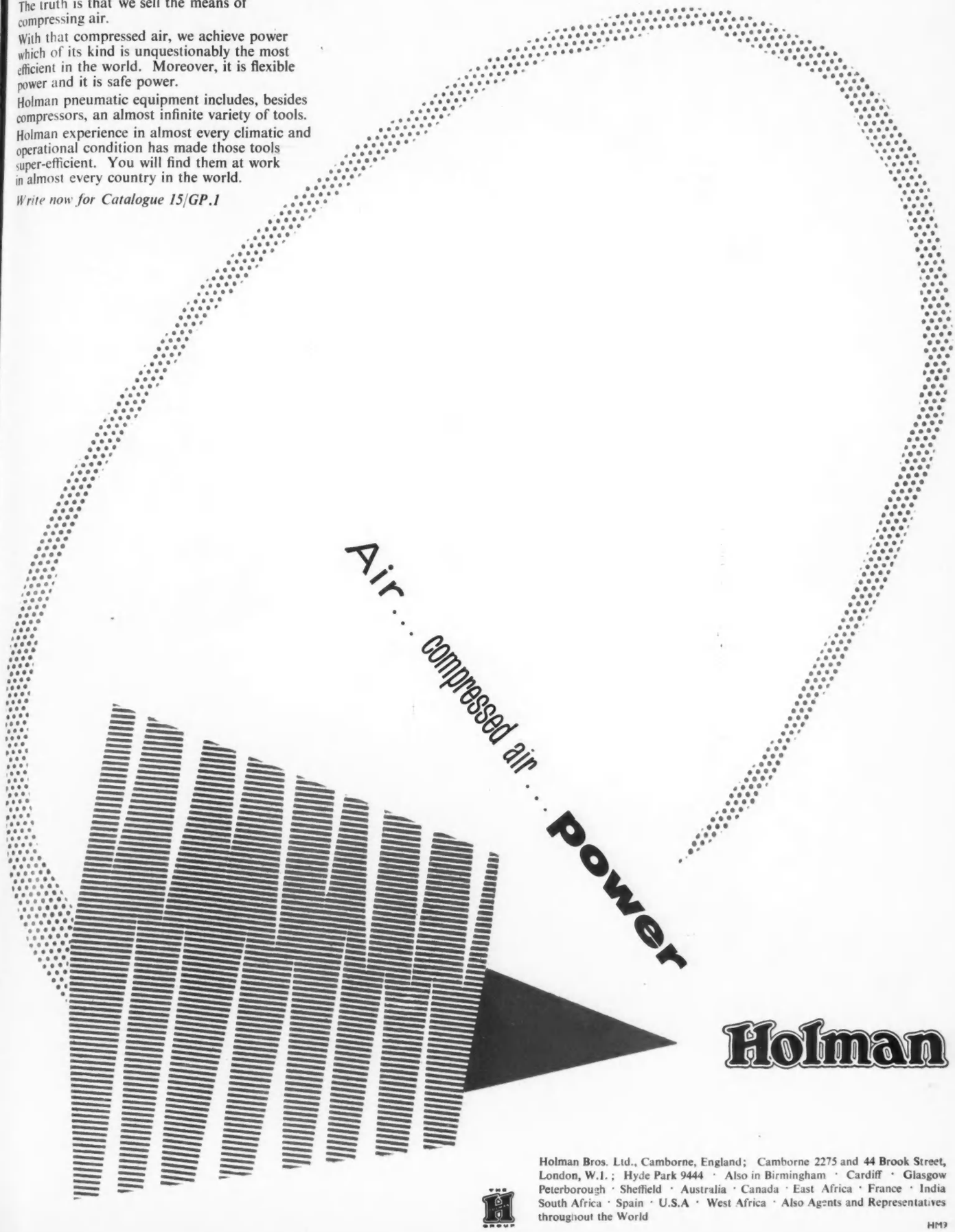

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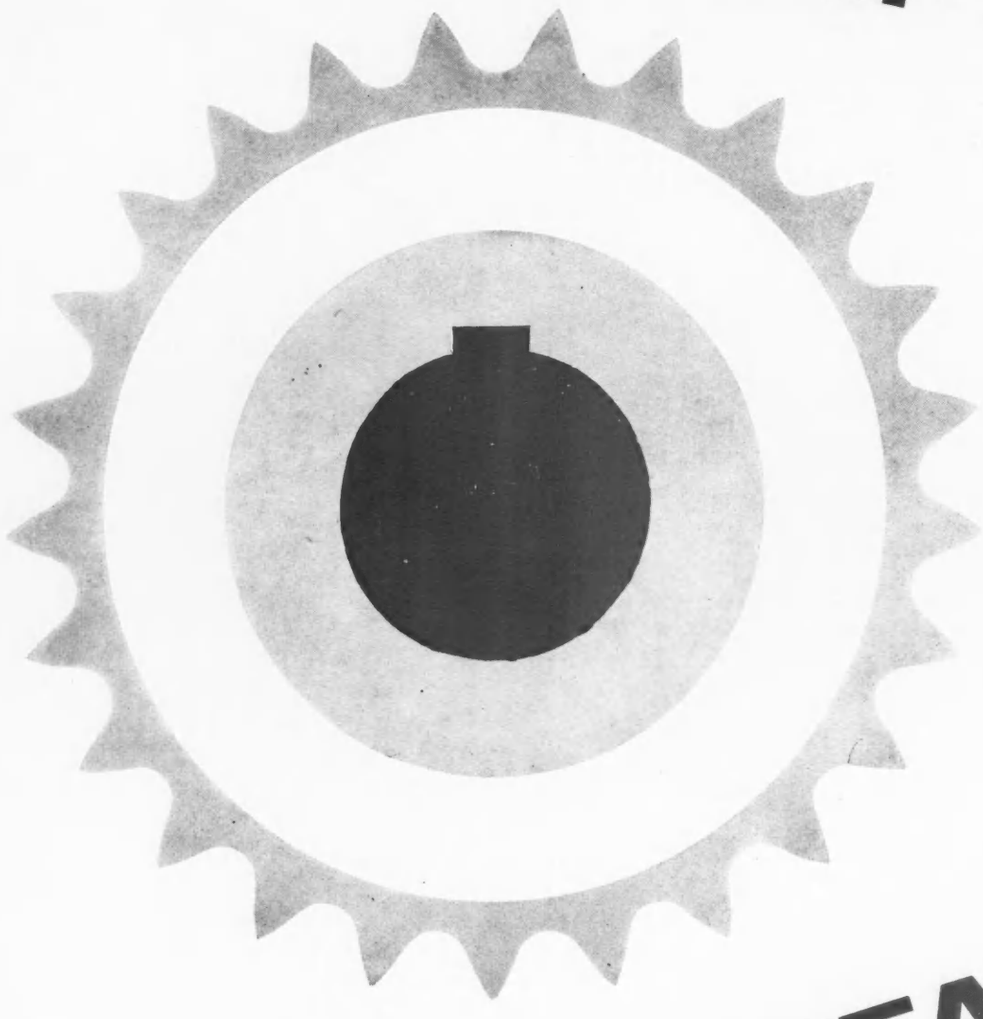

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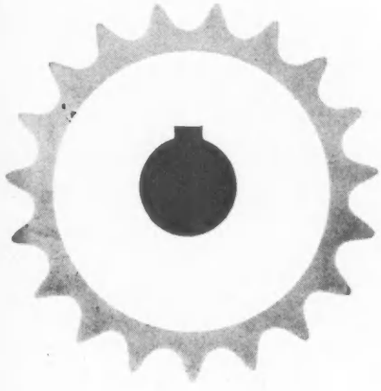

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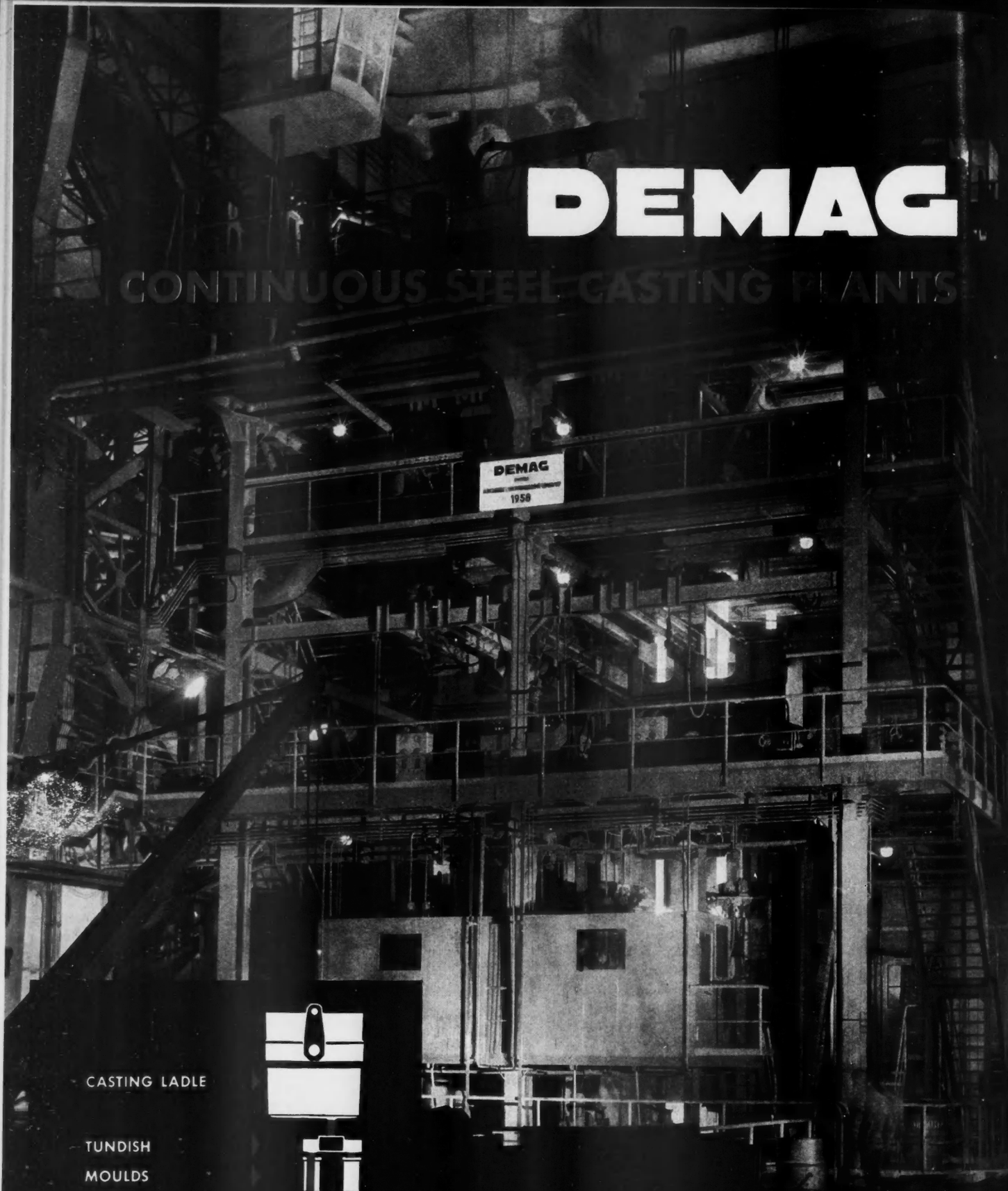

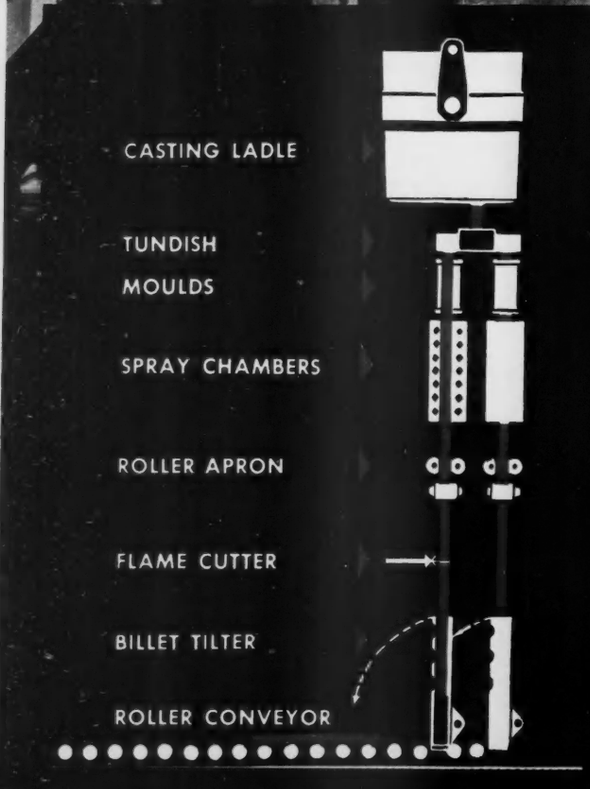

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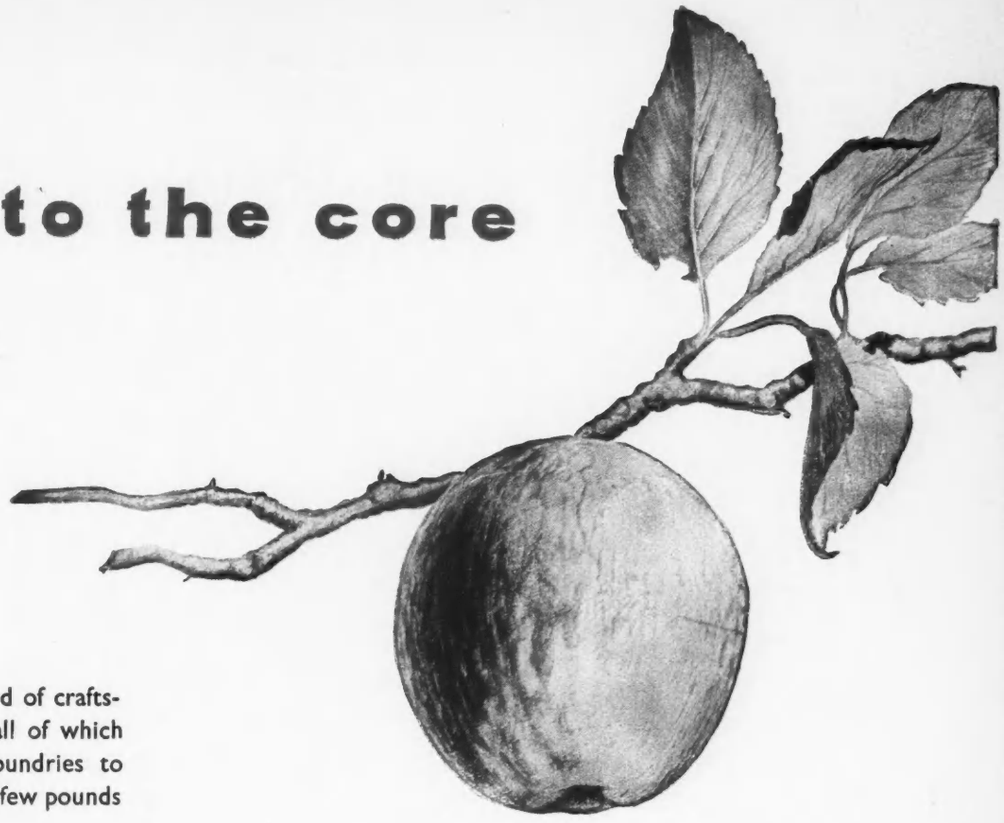

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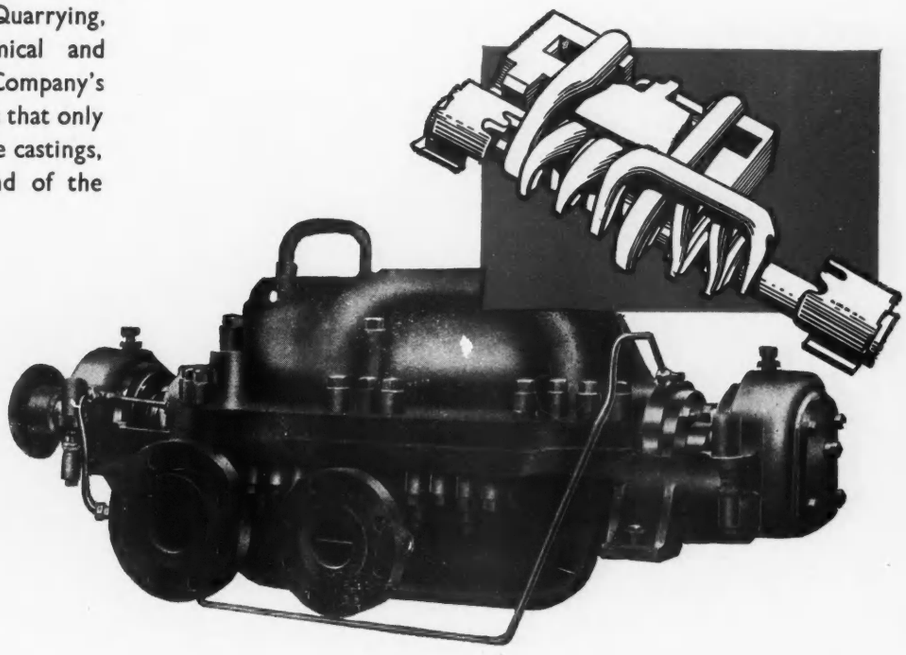

Osborn castings are used in this *Hayward Tyler—Byron Jackson six-stage 'Multiplex' pump.* Inset illustrates core used for casting the upper half of casing.

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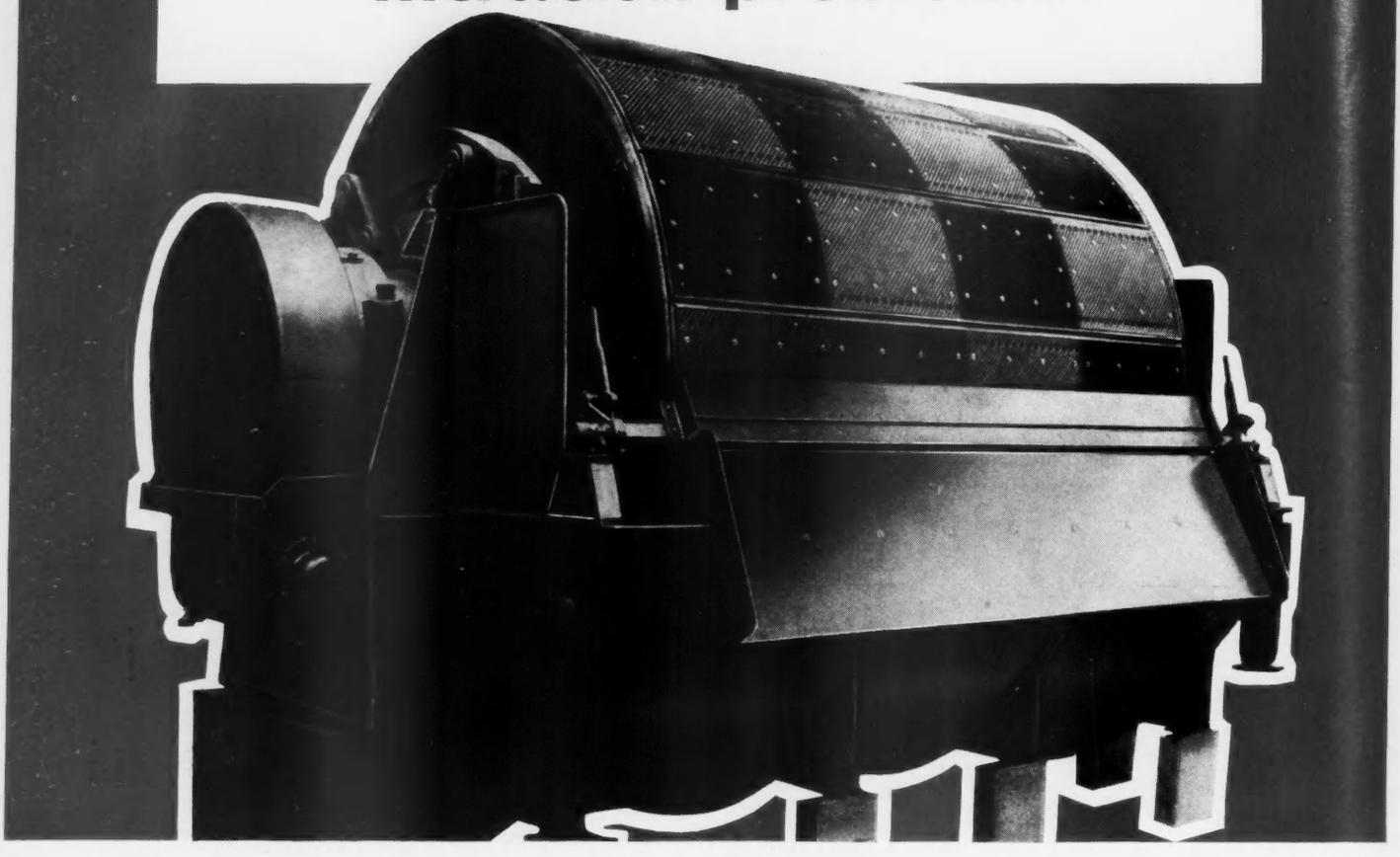

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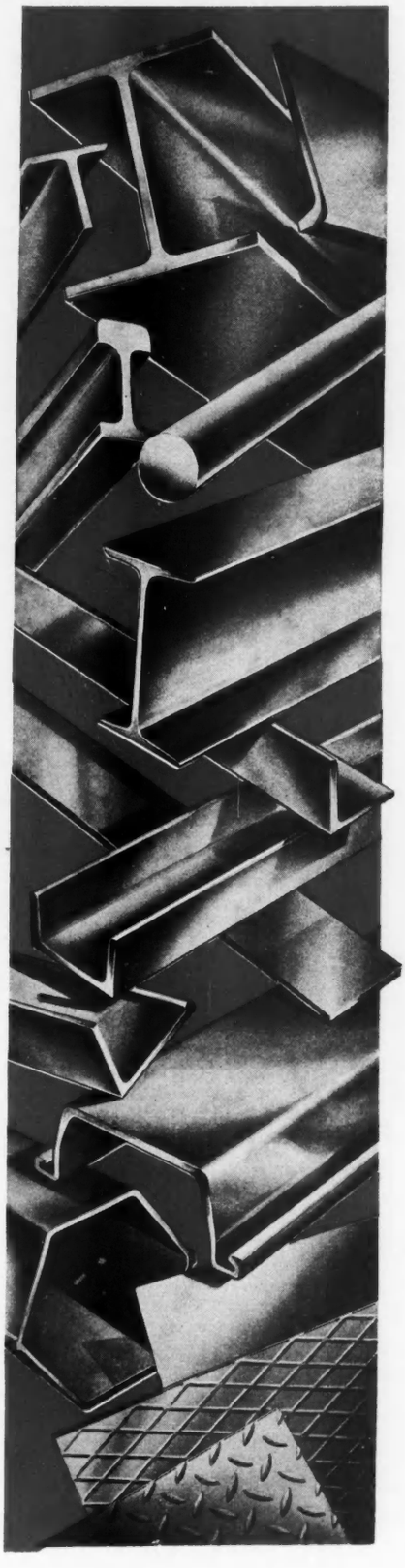

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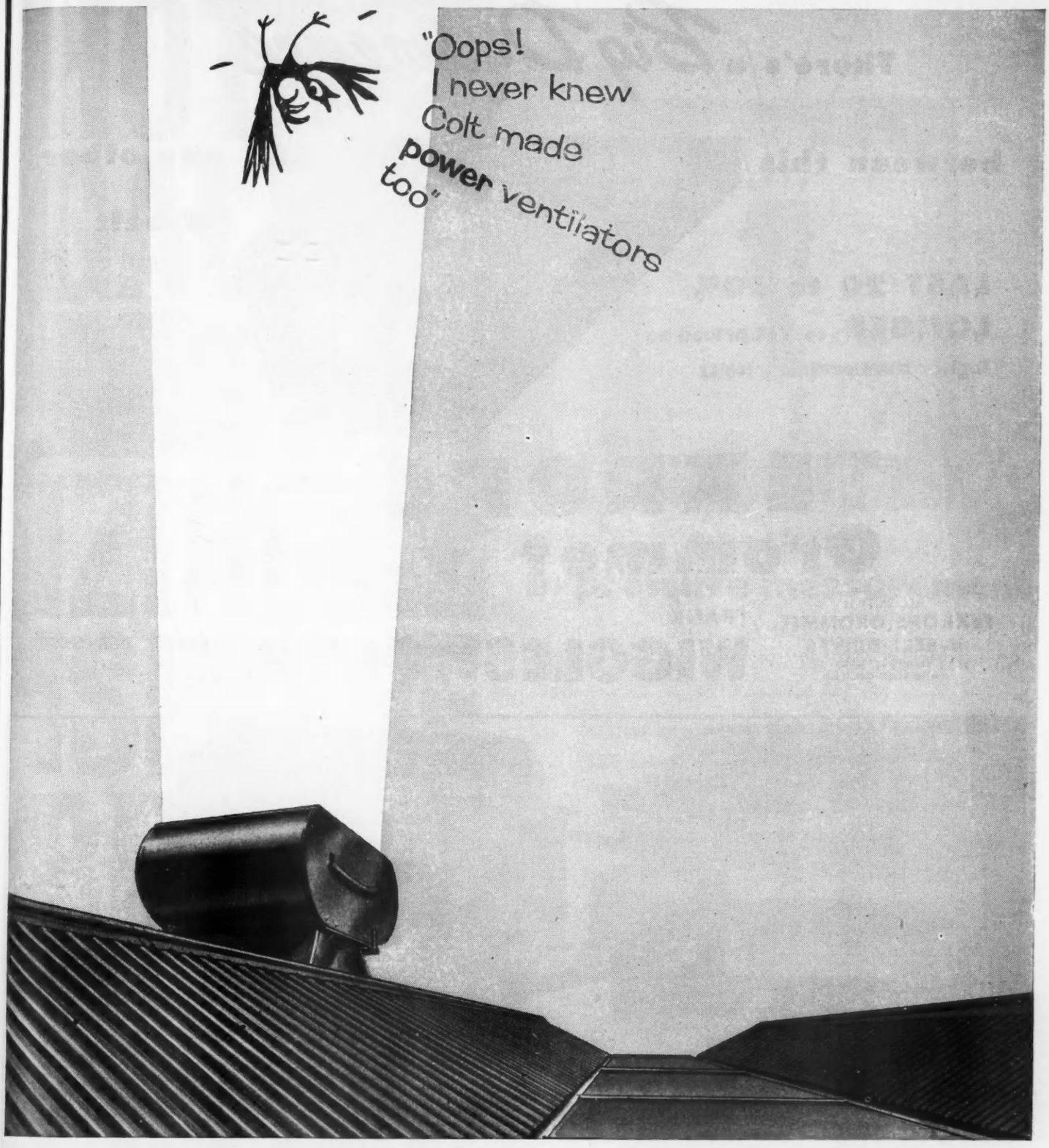

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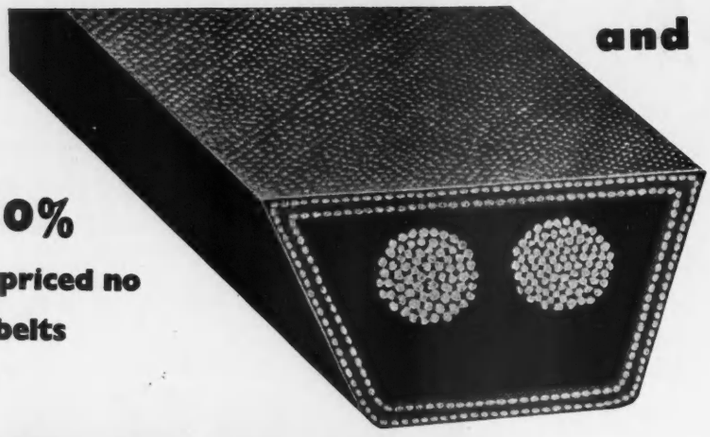
between this  and any other V-belt

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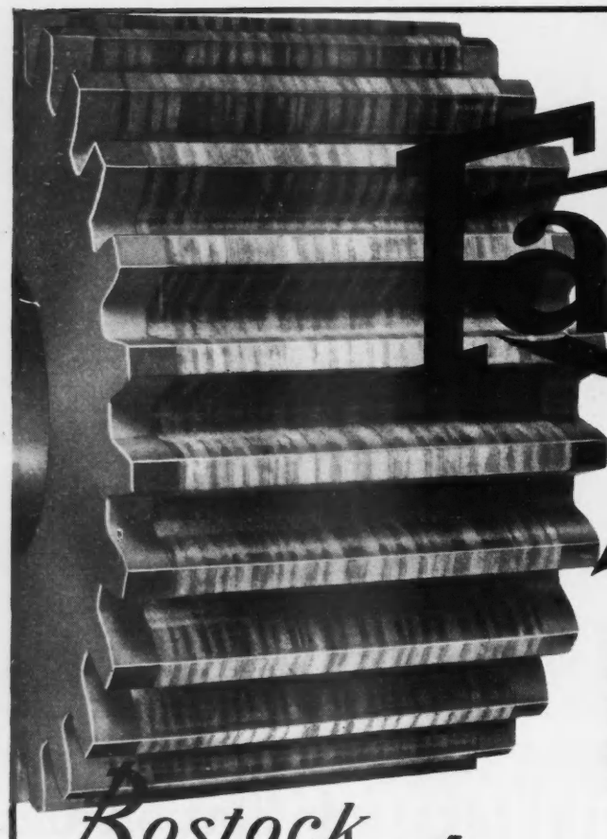

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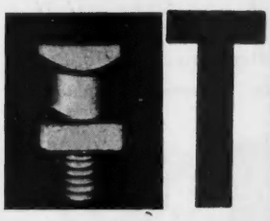

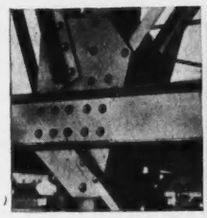

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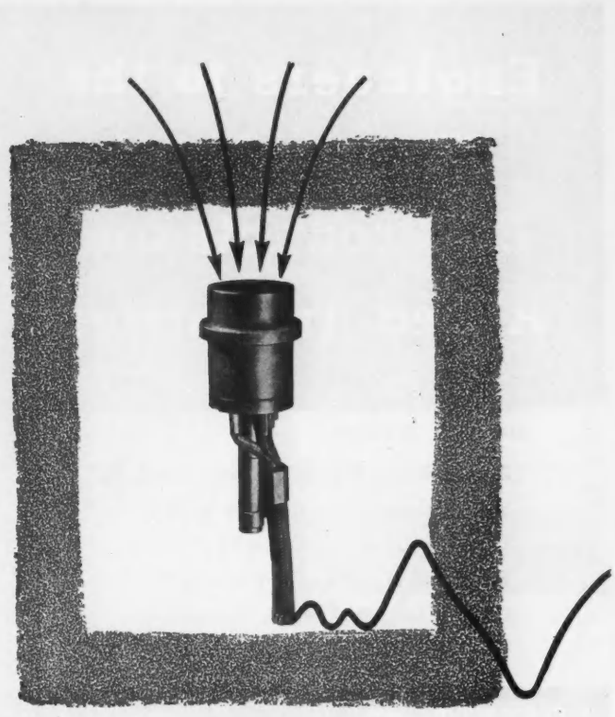

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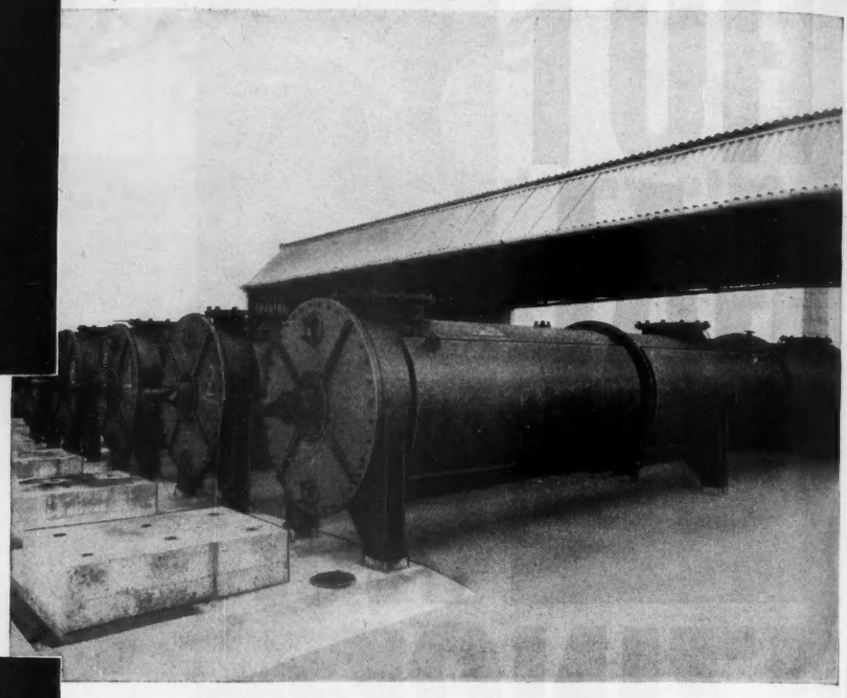

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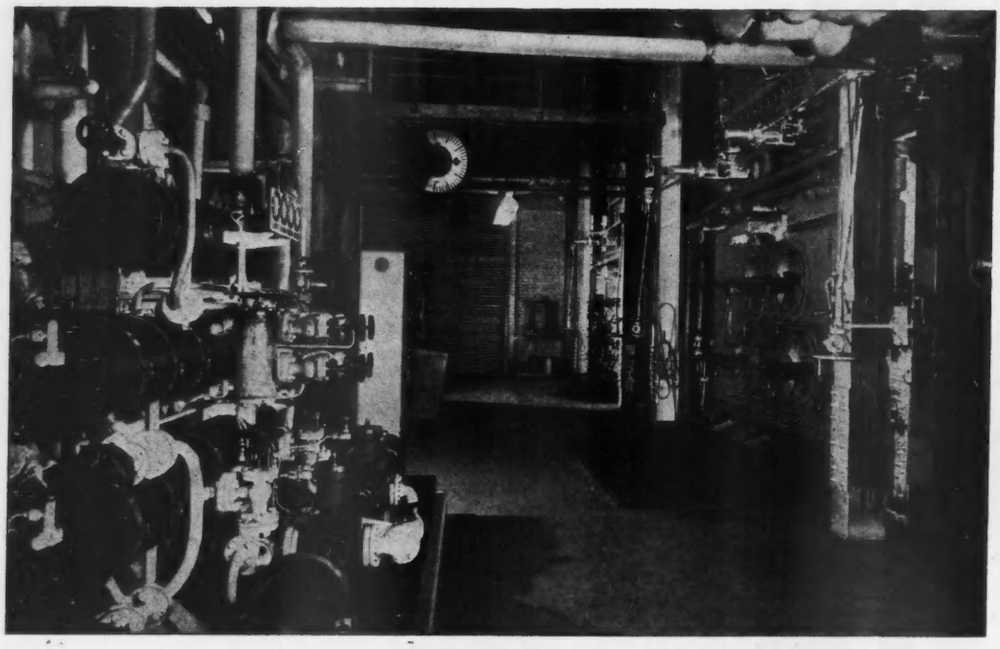

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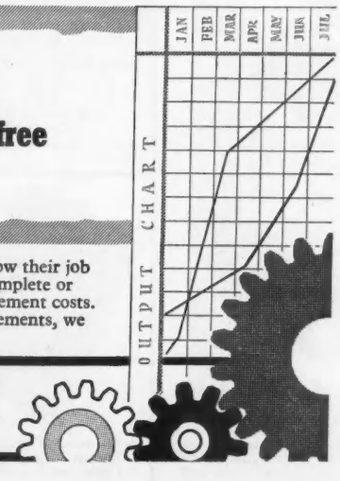

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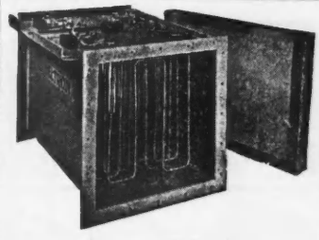

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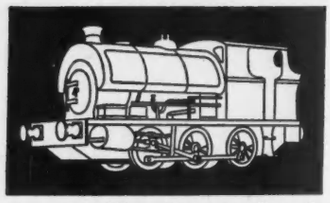

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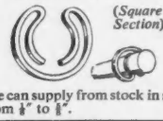

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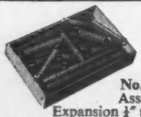

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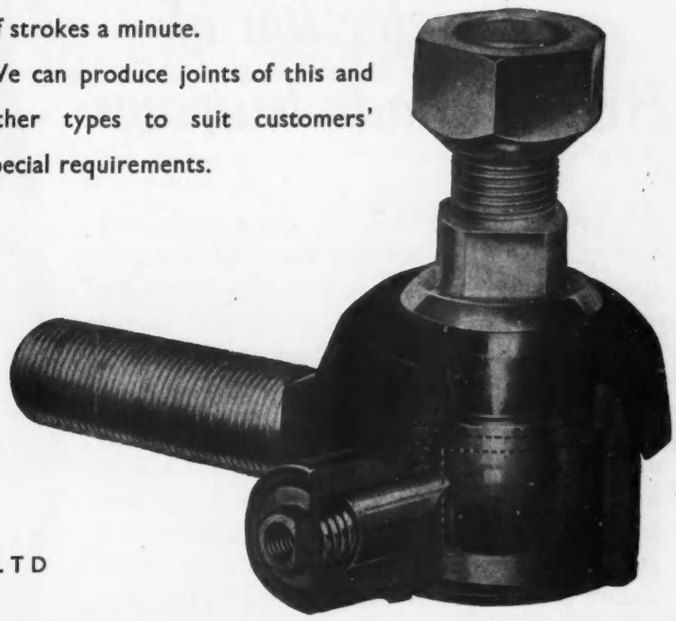

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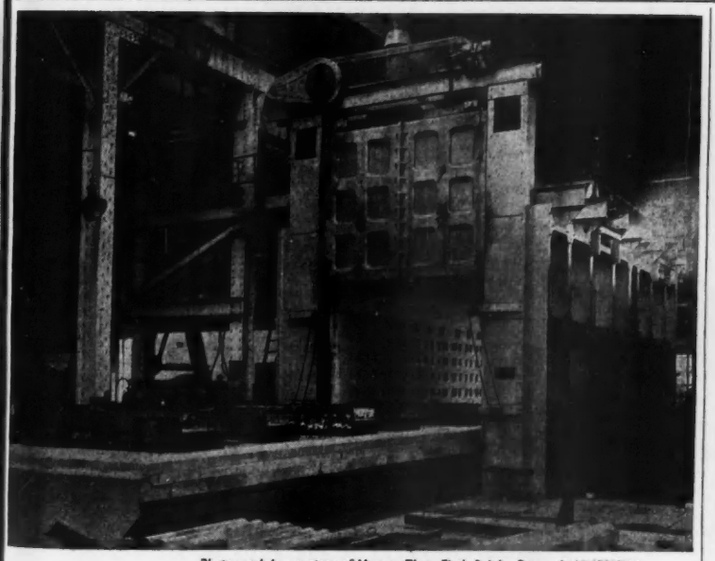

Photograph by courtesy of Messrs. Thos. Firth & John Brown Ltd., Sheffield.

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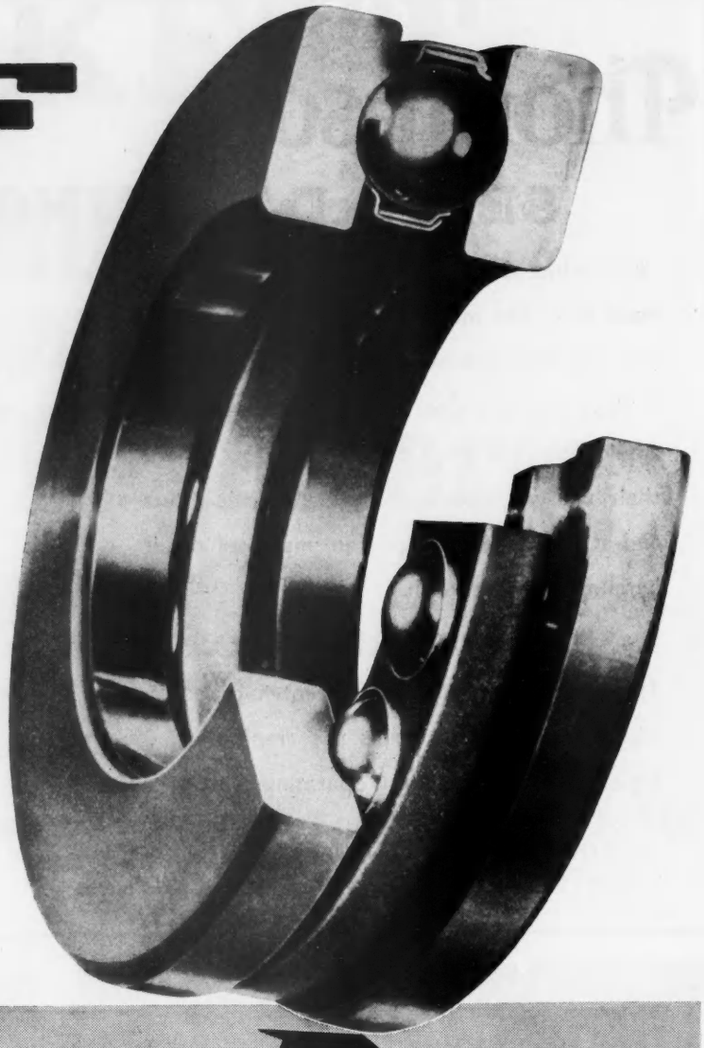

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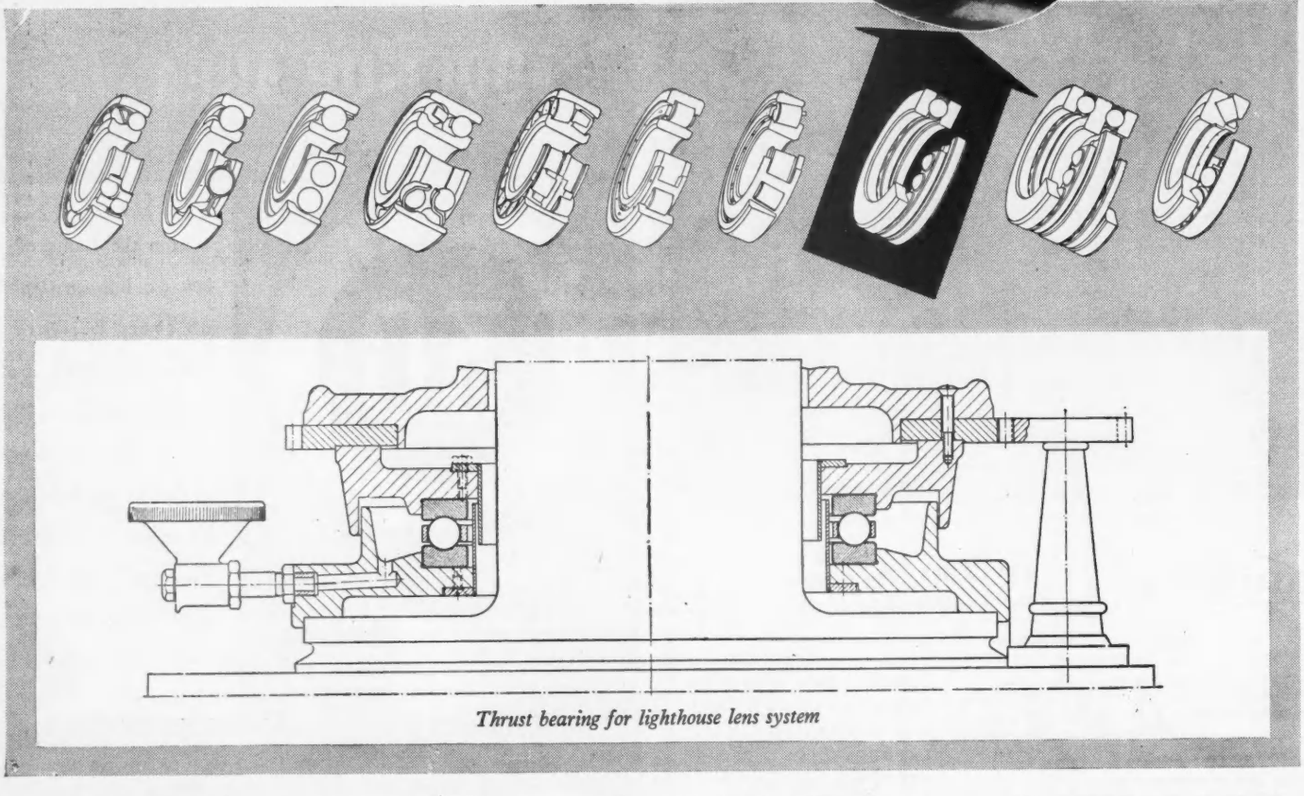

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A 858

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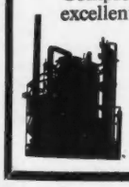

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Grade "B": £700 p.a. by £27 10s. p.a. to £1150 p.a.

Grade "A": £520 p.a. by £27 10s. p.a. to £1000 p.a.

There are additions for approved qualifications and training, and the commencing salary may include increments for approved industrial experience.

Forms of application and further particulars obtainable from the Principal, to whom applications should be returned within two weeks of the appearance of this advertisement.

H. GRAY,
CLERK TO THE GOVERNORS.
A 917

ASSISTANT ENGINEER

ASSISTANT ENGINEER (MECHANICAL) required for their London Office by CROWN AGENTS FOR OVERSEA GOVERNMENTS and ADMINISTRATIONS. Appointment normally to pensionable establishment. Commencing salary between £830 at age 25 and £1125 at age 34 or over in scale rising to £1300. Fully qualified Officers aged at least 27 years may be eligible for special increase of £75 within maximum of scale after 2 years' service. Liberal leave. 5-day week. Candidates must hold degree in Mechanical Engineering and/or be Corporate or Graduate Members of the Institution of Mechanical Engineers and have served a recognised apprenticeship or pupilage to mechanical engineering with subsequent industrial experience. Previous experience of contracts work and a knowledge of machine tools and machine shop equipment and/or refrigeration and chemical plant an advantage. Duties include the purchase of all types of mechanical industrial equipment, adjudication upon tenders and advising overseas administrations on problems connected with mechanical equipment.—Write to the CROWN AGENTS, 4, MILLBANK, LONDON, S.W.1. State age, name in block letters, full qualifications and experience and quote M2A/50852/EI.
A 903

UNIVERSITY OF SOUTHAMPTON

DEPARTMENT OF ELECTRICAL ENGINEERING

Applications are invited for the post of LECTURER OR ASSISTANT LECTURER in Electrical Engineering. Candidates should hold a good degree in electrical (power) engineering.

Salary Scales: Lecturer, £900 by £50 to £1350 by £75 to £1650, with an efficiency bar at £1300. Assistant Lecturer, £700 by £50 to £850. The initial salary will depend on qualifications and experience. Further particulars should be obtained from the SECRETARY AND REGISTRAR to whom applications (7 copies from United Kingdom applicants) should be sent not later than 15th February, 1960.
A 909

VACANCIES FOR TWO ENGINEERING CLERKS

Applications are invited for these two vacancies on the staff of the CHIEF RESIDENT ENGINEER of several large pipelaying contracts in Lanarkshire.

The duties of the successful applicants would include the maintenance of filing systems, checking interim and final certificates of Contractors, copy typing and general office routine.

Previous experience of engineering works office routine would be advantageous.

It is anticipated that the appointments would be for about 18 months.

Salaries would be £600 per annum.

Written applications, with age and full particulars, should be addressed to the Chief Resident Engineer, Daer Water Scheme, c/o The Clerk to the DAER WATER BOARD, P.O. BOX No. 1, LANARKSHIRE HOUSE, 191, INGRAM STREET, GLASGOW, C.1, not later than 20th January, 1960. Interviews by appointment will be held in Glasgow during the first week in February.
A 906

CIVIL ENGINEERS FOR DEPARTMENT OF MAIN ROADS, NEW SOUTH WALES, AUSTRALIA

Applications are invited from GRADUATES (or undergraduates in their final year) in Civil Engineering of a recognised British or Irish University for appointment to the staff of the Department of Main Roads, New South Wales, the State Road Authority for construction of roads and bridges.

On appointment, applicants may be engaged at the Department's Head Office, Sydney, on the design of reinforced concrete and steel bridges, or on main road construction and maintenance either in the Metropolitan Area or the country.

Commencing salary according to qualifications and experience will be within the range £A1185 to £1410 per annum, with annual progression, subject to technical competence to £A2095 per annum. Appointees will be eligible to contribute to the State Superannuation Fund after six months.

Appointee's full fare from England to Australia will be met by the Department, subject to a three years' service guarantee bond being completed. Appointment will be subject to passing a medical examination and preference will be given to applicants not more than 30 years of age.

Applications should be made on forms obtainable from the AGENT GENERAL FOR NEW SOUTH WALES, 56 STRAND, LONDON, W.C.2. When replying, please quote this paper.
A 907

THE BRITISH SOCIETY FOR RESEARCH IN AGRICULTURAL ENGINEERING

SENIOR SCIENTIFIC OFFICERS (2) required for research and development work in agricultural engineering.

Hillside cultivation: Physicist or engineer with honours degree or equivalent to investigate behaviour of tractors and implements on hillsides, particularly effects of forces arising from slopes on motion of machines.

Mechanical handling: Mechanical engineer with honours degree or equivalent to undertake research into functional and mechanical requirements of farm machinery particularly potato harvesters.

Previous research and report writing experience essential. Minimum age 30. Salary £1166 to £1380. Posts superannuated.

Further particulars and forms of application from the SECRETARY, N.I.A.E., SCOTTISH STATION, HOWDEN, MID CALDER, MIDLOTHIAN.
A 902

APPOINTMENTS OPEN

ENGINEER

ENGINEER for work in connection with site investigations and soil mechanics laboratory required immediately by CONSULTING ENGINEERS, F. R. BULLEN & PARTNERS, DACRE HOUSE, DEAN FARRAR STREET, LONDON, S.W.1.
A 887

DRAUGHTSMEN

DRAUGHTSMEN required in Technical Department of first-class engineering company of repute in Newark, pension scheme, etc.—State age, experience, qualifications and salary required, to BOX A 921, Offices of ENGINEERING.

VACANCIES FOR FIVE RESIDENT ENGINEERS

Applications are invited from Civil Engineers to supervise pipelaying contracts in Lanarkshire. The work would embrace setting-out, supervision of excavations in varying formations including rock, the laying in trenches of large diameter steel pipes with "Viking Johnson" couplings and other ancillary works, and the checking of contractors' interim certificates. It is anticipated that the appointments would be for about 18 months.

Applicants must be Corporate Members of the Institution of Civil Engineers, preferably with experience in similar works.

Salaries would be in the range £1200-£1450 per annum depending upon age and experience.

Written applications, with age and full particulars, should be sent to MESSRS. BINNIE, DEACON & GOURLEY, CONSULTING CIVIL ENGINEERS, ARTILLERY HOUSE, ARTILLERY ROW, WESTMINSTER, LONDON, S.W.1, not later than 11th January, 1960.
A 914

KELLOGG INTERNATIONAL CORPORATION

the leading contractors in petroleum refinery and chemical plant construction, invite applications for the following positions:—

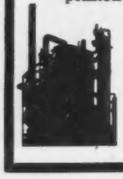
HEAT TRANSFER ENGINEER

Applicants should have University Degree in Chemical or Mechanical Engineering, plus 3 years' service in industry—or H.N.C. plus 5 years' experience in industry—should be experienced in process or power plant design and must be capable of carrying out all thermodynamic calculations necessary for the design of Heat Exchangers. The selected applicant will be responsible for analytical, thermal and mechanical design of Heat Exchangers and Furnaces; preparation of data sheets and specifications for Exchangers; Thermal calculations for Heat Exchangers; preparation of Exchanger setting plans and drawings; checking of these diagrams and drawings; review of quotations and vendors' drawings for Heat Exchangers and Furnaces.

INSTRUMENT ENGINEERS

Candidates must have University Degree with 4 years' experience in Instrument Engineering, or H.N.C., with 6 years' experience. Experience should preferably be in refinery process instrumentations. Operating experience would be an advantage. Duties of the successful applicants will cover the selection of instruments, the determination of their location, and applications in the process; preparation of process control diagrams, instrument specifications and data sheets; writing of requisitions and review of vendors' quotations; instrument calculations, locating the physical position of instruments and the preparation of instrument board layouts.

Above average salaries, comprehensive personnel benefits include contributory pension scheme, excellent working conditions, luncheon vouchers, social club, etc.



Please write to the Personnel Manager:

KELLOGG INTERNATIONAL CORPORATION

KELLOGG HOUSE, 7/10, CHANDOS STREET, LONDON, W.1,

QUOTING REFERENCE 148/*H*. Telephone: MUSeum 4010 A 919

A DESIGN ENGINEER

is required by

TEXACO TRINIDAD, INC. IN TRINIDAD

Applicants should have at least three years experience in refinery process equipment design including pressure vessels, heat exchangers, etc., or similar design work including process pipework. Knowledge of pipe stressing calculations is desirable. They should also have a University degree in chemical or mechanical engineering, or associate or graduate membership of either of the corresponding Institutions.

The starting salary for this pensionable position will be between £1400 and £1600 depending on experience and qualifications. Subsidised housing and schooling for children will be available.

Please write with brief particulars to the **PERSONNEL OFFICER, TRINOIL (U.K.) LIMITED, 29/30 OLD BURLINGTON STREET, LONDON, W.I.** A 923

SENIOR APPLICATIONS ENGINEER

THE GLACIER METAL COMPANY invites applications for two posts of SENIOR APPLICATIONS ENGINEER. The company has recently established within its Research and Development Organisation a new department whose function is to use the latest research knowledge in advising customers on all aspects of bearing design. Two appointments are now to be made, in each of which the Engineer will be responsible to the Manager of the new department and will have initially one assistant. The work entails a wide and interesting range of contacts in the engineering industry. As Technology advances new mechanical designs raise new bearing problems and new bearing designs make possible innovations in the design of machinery. A senior Applications Engineer is responsible both for devising solutions to bearing problems raised with the Company by its customers and for searching out areas where such innovations are practical. Applicants should have a good Honours Degree in Engineering, Physics or Mathematics, together with a completed apprenticeship. Experience in Research, Design or Development work would be useful. SALARY RANGE, £1350 to £1850 per annum. Applications should be sent to

PERSONNEL DIRECTOR (Ref.: SAE), THE GLACIER METAL COMPANY, EALING ROAD, ALPERTON, WEMBLEY, MIDDX. A 904

HYDRAULIC DEVELOPMENT ENGINEER

required to take control of a Development Section specialising in Industrial Hydraulic Applications.

The post is a senior one which has been created within a Division of a Group of Companies of National Repute and it offers considerable scope to a man with ability, drive and imagination.

The commencing salary scale is £1200 to £1600 p.a., depending upon experience and qualifications. A Pension Scheme is in operation. Assistance will be given in housing and removal expenses to the North of England.—Apply BOX A 922, Offices of ENGINEERING.

DRAUGHTSMEN DESIGNERS

UNILEVER LIMITED invite applications for appointments as MECHANICAL ENGINEERING DRAUGHTSMEN/DESIGNERS in the London Office of their Associated Company, T. Wall & Sons (Ice Cream) Ltd. Qualifications equivalent to Higher National Certificate are preferred and some workshop training essential. Experience required is in layout drawings for processing equipment and design of process equipment. Starting salaries according to age and experience.—Written applications, giving full particulars of qualifications, training and experience, to be addressed to HEAD OFFICE STAFF DEPARTMENT (WF 50), UNILEVER HOUSE, BLACKFRIARS, LONDON, E.C.4. A 900

MOTOR RAIL LIMITED

DESIGNER required for development work. Candidates should have served a Mechanical Engineering Apprenticeship and possess a university degree in engineering or the equivalent. They should be within the age range 30 to 45 and have had experience in medium weight mechanical engineering. Applications, giving date of birth and full details of education, qualifications and experience, should be addressed to the SECRETARY, MOTOR RAIL LTD., SIMPLEX WORKS, ELSTOW ROAD, BEDFORD. A 910

VACANCIES FOR TWO ASSISTANT RESIDENT ENGINEERS

Applications are invited from Civil Engineers to supervise pipelaying contracts in Lanarkshire. The work would embrace setting-out, supervision of excavations in varying formations including rock, the laying in trenches of large diameter steel pipes with "Viking Johnson" couplings and other ancillary works, and the checking of contractors' interim certificates. It is anticipated that the appointments would be for about 18 months.

Applicants must have passed Parts (*a*) and (*b*) of the Examination of the Institution of Civil Engineers and preferably have had experience in similar works.

Salaries would be in the range £950-£1050 per annum depending upon age and experience.

Written applications, with age and full particulars, should be sent to MESSRS. BINNIE, DEACON & GOURLEY, CONSULTING CIVIL ENGINEERS, ARTILLERY HOUSE, ARTILLERY ROW, WESTMINSTER, LONDON, S.W.1, not later than 11th January, 1960. A 912

VACANCIES FOR TEN INSPECTORS OF WORKS

Applications are invited from Inspectors of Works to supervise pipelaying contracts in Lanarkshire.

The work would embrace supervision of excavations in varying formations including rock, the laying in trenches of large diameter steel pipes with "VIKING JOHNSON" couplings, other ancillary works, the measurement of completed works and checking of contractors' interim certificates.

It is anticipated that the appointments would be for about 18 months work. Salaries would be in the range £750-£850 depending upon age and experience.

Written applications, with age and full particulars, should be sent to MESSRS. BINNIE, DEACON & GOURLEY, CONSULTING CIVIL ENGINEERS, ARTILLERY HOUSE, ARTILLERY ROW, WESTMINSTER, LONDON, S.W.1, not later than 11th January, 1960. A 913

STRUCTURAL ENGINEERING DESIGNER

STRUCTURAL ENGINEERING DESIGNER required in London Office of Consulting Engineers. Should have a University Degree in Engineering or the Associate Membership of either the Institution of Civil or Structural Engineers and must have had at least one year's experience on the design of structural steelwork. Some experience on reinforced concrete design would also be an advantage. Salary according to experience. Five-day week. Pension Scheme. Luncheon Vouchers.—Apply stating age and experience to BOX A 812, Offices of ENGINEERING.

ADVERTISEMENT RATES

'Engineering' Appointments Section

CLASSIFICATIONS: Public Appointments, Appointments Open, Appointments Wanted.

TYPES OF ADVERTISEMENTS:

(a) "Appointments Illustrated" and illustrated careers advertisements: photographs or drawings may be used in conjunction with type matter.

Rates: per page (12 in. by 9 in.) ..	£90
per half page	£48
per quarter page	£25 10s.

(b) Semi-display: type matter, with or without surrounding rule, name block or symbol.

Rates: per page (12 in. by 9 in.) ..	£90
per half page	£48
per quarter page	£25 10s.
per single column inch ..	£2 8s.

(c) Single column "run-on" advertisements: approximately 6 words to the line, 12 lines to the inch.

Rate per line	4s.
(Minimum charge 16s.)	

SERIES DISCOUNTS: 5 per cent. on 6 insertions; 10 per cent. on 13; 15 per cent. on 26; 20 per cent. on 52.

BOX NUMBER: 2s.

Company Meetings

Quarter page £30 : half page £60 : full page £120

COPY DATE: First post Monday.

BLOCKS: To be mounted ready for printing. Screen 100.

ORDERS TO: "Engineering," 36, Bedford Street, London, W.C.2. Telephone TEMple Bar 3663).

COMPANY MEETING

WALTER SPENCER & COMPANY

TRADE RECESSION AFFECTS RESULTS.

The twenty-third annual general meeting of Walter Spencer & Co. Limited was held on December 17 at Sheffield, Mr. Herbert Priest, chairman, presiding.

The following is an ext ct from his circulated address:—

The Accounts and Balance Sheet covering our trading for the twelve months ending 30th September, 1959, show a Gross Trading Profit of £74,907 as compared with £87,545 for the twelve months ending 30th September, 1958.

The serious recession of business has continued throughout this year in every department. For the greater part of the year our High Frequency Melting, Heavy Press and Forge Departments have worked only four days per week on single shifts and we have had very great difficulty in keeping the reduced personnel of all our Tool Departments fully occupied for the normal five-day week.

The consequential result of this continued recession is that we have experienced an overall reduction in turnover of approximately 20% and in view of this I consider that our Gross Trading Profit this year of £74,907 is very satisfactory.

Last year I was unable to make any responsible prophecy with regard to forward prospects and the same applies this year except that within the last few weeks, we have experienced an upsurge of orders in our Steel Department, mainly for Heavy Bars, Forgings, Rings and Blank Forgings which I feel will continue to increase month by month and I trust this improvement will soon be reflected in all our Tool Departments for we have had a most difficult trading year in Tools, not only because of the reduced number of orders received owing to the shrinking requirements of our customers but also because of the completely irresponsible and entirely unnecessary price cutting we have experienced particularly in Milling Cutters, Hobs and Twist Drills.

We have recently concluded an agreement with Messrs. W. Ferd Klingelnberg Sohne, of Remscheid, Germany, to manufacture under Licence from them and to British Patent Specification No. 794912 Special Roughing Hobs which we feel will completely revolutionise the roughing out times of Gear Cutting. These special roughing hobs have been in production for several years at the works of Messrs. W. Ferd Klingelnberg Sohne in Remscheid and are also in production under licence in France and Italy with very successful results.

The profit before taxation is £46,993 compared with £67,588 last year. The amount of estimated tax this year is £25,000 against £29,000 last year. Our net profit this year is £21,993 compared with £38,588 last year and we are carrying forward this year £36,670 compared with £44,927 last year.

Your Directors recommend a Final Dividend of 10 per cent less Income Tax which together with the Interim Dividend of 5 per cent. paid in May, 1959, on the original capital of £100,000 will provide a gross dividend on the original 500,000 ordinary shares of 15 per cent. As the free issue of 250,000 shares made in May, 1959, will also rank for the Final Dividend of 10 per cent. the total Dividend paid is equivalent to 20 per cent. on the original Capital of £100,000.

The Capital of the Company was increased to £200,000 in May last and we propose to offer for subscription the remaining 250,000 unissued Ordinary Shares of 4/-d each in the early part of 1960.

The report was adopted. A861

METROVICK RADIANT SPACE HEATERS can be used in countless situations indoors and out where other methods are either too costly or impracticable. They provide an efficient and highly economical method of heating churches, canteens and other buildings which are occupied only for short, intermittent periods.

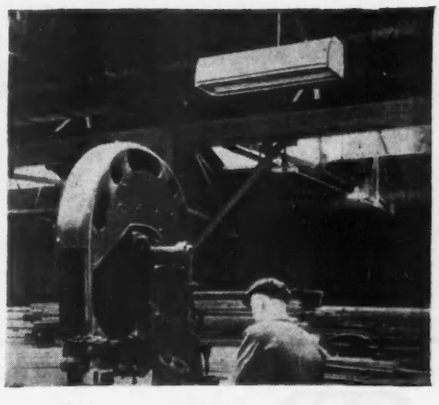
A Metrovick radiant space heater suspended on conduit.

Warmth

projected where and when you want it!

In canteens, billiard rooms and other areas, heating costs are confined to periods of actual use with Metrovick radiant heaters.

At gates and entrances for watchmen and porters, as well as for attracting custom to shops, Metrovick radiant space heaters give highly efficient local warmth with economy.



Localised warmth at machines and work benches, without the waste involved in heating unoccupied areas, is provided by Metrovick radiant space heaters.

The heater consists of an anodised aluminium reflector with a tubular sheathed, corrosion-resistant heating element and is available in 1½ and 3 kW ratings. Weighing less than 5 lb., it is easily erected on a single 1 in. conduit leading from the weather-proof, aluminium alloy terminal box. It can also be supplied with an ornamental bezel, allowing it to be mounted on conduit, built into the ceiling or suspended from chains.

Please write for fully illustrated leaflet

PLEASE HELP SPASTICS

Associated Electrical Industries Limited

TRANSFORMER DIVISION — HEATING & WELDING DEPARTMENT

Trafford Park - - - Manchester 17

TGA/L/1803

F

Who are the best people for grinding & sifting plants?

C & N....

C & N ...

C & N ..

Christy ...

Christy and something ...

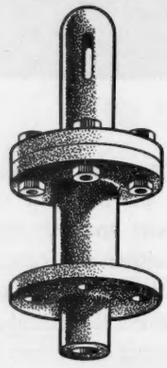
Christy and Norris that's it ...

CHRISTY & NORRIS, LTD

DISINTEGRATORS, PULVERIZERS AND LABORATORY MILLS including a range of mills in PHOSPHOR BRONZE OR STAINLESS STEEL.
SIFTING AND MIXING MACHINES, ETC.
Complete grinding and sifting plants, designed and installed.

Chelmsford · Essex · Telephone 3414-7

This boiler fitting cost thousands of pounds



This boiler fitting was supposedly doing its job as a low water alarm. It wasn't, and the resultant explosion not only cost the firm a boiler house, but a crippling loss of profits.

—and two people could have prevented the accident

An accident like this, caused by a defect in the working parts of the apparatus, need never happen — if a qualified Engineer Surveyor regularly inspects machinery. But first it is the responsibility of someone at top-level — a director, the secretary or chief engineer — to see that all their industrial machinery is regularly inspected and properly insured by specialists.

1859 1959

Vulcan inspects and protects

Vulcan, who this year celebrate a century of experience — and look forward to learning more every day—provide just such a service. It costs no more than insurance and inspection by 'general practitioners'. Our appointment is always welcomed by company engineers and insurance brokers — because they know that if defects are to be found, a Vulcan Engineer Surveyor will find them, and prevent the accident that would have happened.

MAY WE SEND YOU FREE

'Vulcan'—a journal for all users of plant and machinery with reports of accidents and safety hints. Write to Dept. 19.

THE Vulcan 67 KING STREET MANCHESTER 2

BOILER & GENERAL INSURANCE CO. LTD.

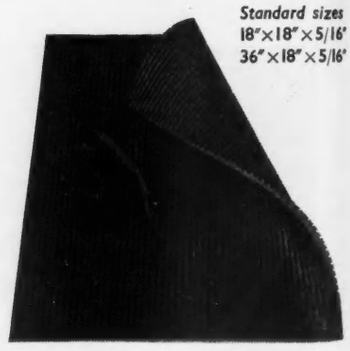
VULCASCOT ANTI - VIBRATION PADS

THE OIL RESISTING
RUBBER MACHINE MOUNTINGS

Tested and proved by years of usage

★ Check vibration, shock and noise
★ Make machine installations easy
★ No fixing bolts required
★ Save maintenance time and cost
★ Combat nervous strain
★ Isolate loads up to 4 tons per sq. ft.

Standard sizes
18"×18"×5/16'
36"×18"×5/16'



MAKE MACHINES MOBILE

VULCASCOT LEVEL-MOUNTS

incorporate the Anti-Vibration Pads

NO DRILLING OF FLOORS

RAPID LEVELLING WITHOUT SHIMS

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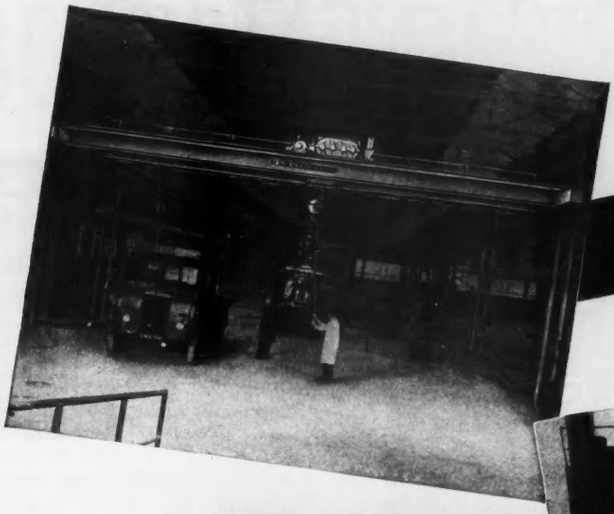
VULCASCOT (GT. BRITAIN) LIMITED

87-89 ABBEY ROAD, LONDON, N.W.8.

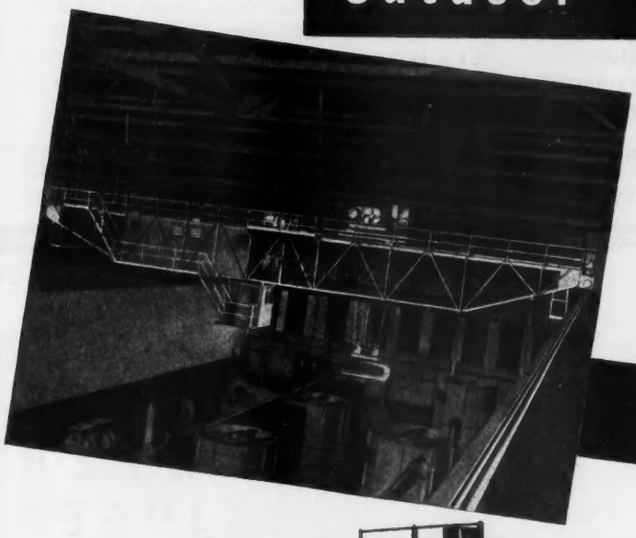
Telephone MAlda Vale 7374/5

OVERHEAD CRANES



Floor Operated

Outdoor



for Semi-Steelworks Duty

with Revolving Jib

Whatever type you need-call in

JOHN SMITH (KEIGHLEY) LTD

P.O. Box 21 · THE CRANE WORKS · KEIGHLEY · YORKS Tel: Keighley 5311 (4 lines) Grams: Cranes, Keighley

London Office: Buckingham House, 19/21 Palace St. (Off Victoria St.), London S.W.1
Telephone: Tate Gallery 0377/8

Southern Counties Office: Brettenham House, Lancaster Place, Strand, London W.C.2
Telephone: Temple Bar 1515

John Smith CRANES

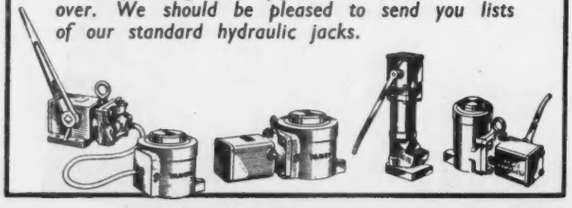
F 2

Tangye Jack

GOES TO SEA

C. S. ALLOT & SON, CONSULTANTS

Tangye Jack is not always in such spectacular employment. He is more often of a standard size and shape doing everyday jobs in all fields the world over. We should be pleased to send you lists of our standard hydraulic jacks.



This reinforced concrete cooling water intake caisson at Hinkley Point Atomic Power Station was built by Taylor Woodrow Construction Ltd., who, in association with the English Electric Company and Babcock & Wilcox Ltd., are responsible for the design and construction of this 500 mW station for the Central Electricity Generating Board. It weighs nearly 4,000 tons, and was towed out to its position in the Bristol Channel where it was lowered on eight hydraulically operated "spud legs" to the sea bed. TANGYE HYDRAULIC POWER IN THE FORM OF EIGHT 500-TON JACKS INCORPORATED IN THE LEGS WERE THEN OPERATED TO LEVEL THE STRUCTURE.

TANGYES LIMITED
SMETHWICK · BIRMINGHAM · Phone SME 1181

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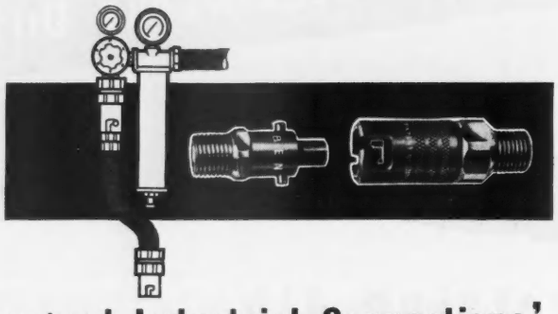
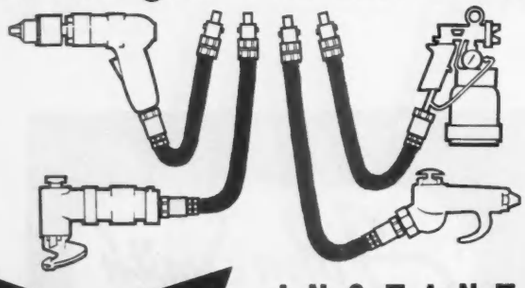
maximum air flow–lowest pressure drop positive air seal – one hand operation

¼" ⅜" ½" sizes b.s.p. male and female connections



'We have good Industrial Connections'

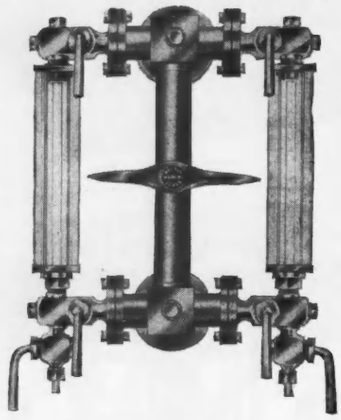


B.E.N.
the symbol of quality

INSTANTAIR couplings

B.E.N. PATENTS LTD. (Division of Broom & Wade Ltd.)
Dept. C6. HIGH WYCOMBE, BUCKS.

C.P338



BOILER WATER GAUGES

- Three sided glass guards.
- Polished cast gunmetal throughout.
- Screwed and flanged versions in all sizes.
- Fully asbestos-packed for easy and reliable operation.
- Automatic shut-off valve in case of glass breakage.
- Range includes various designs for all pressures up to a maximum of 250 lb/in.²

ROBERT HARLOW & SON LIMITED
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TELEGRAMS: "HARLOW, STOCKPORT"
TELEPHONE: STO 3403/4/5.
LONDON OFFICE: 10 NORFOLK STREET, LONDON W.C.2. Telephone: COVent Garden 0315/6/7. Telegrams: "TUBENPIPE" - Phone - London.

CW 5281

SENSIBLE SAFETY

Everybody understands why dangerous animals have to be kept behind bars, and so instances of people being injured by caged wild animals are fortunately rare.

Moving machinery and tools can also inflict serious injury, and it is no less important that these, too, should be securely guarded and fenced.

Safety First with

'HARCO' MACHINERY GUARDS

'Harco' Machinery Guards are purpose made for every type of machinery, and are constructed to afford complete protection without interfering with efficient operation. They are strongly made from stout wire mesh to withstand vibration and rough treatment, and all 'Harco' Guards fully conform to Factory Act requirements. The complete Harvey service covers advice, design and installation, and List No. 996 shows many types already supplied.

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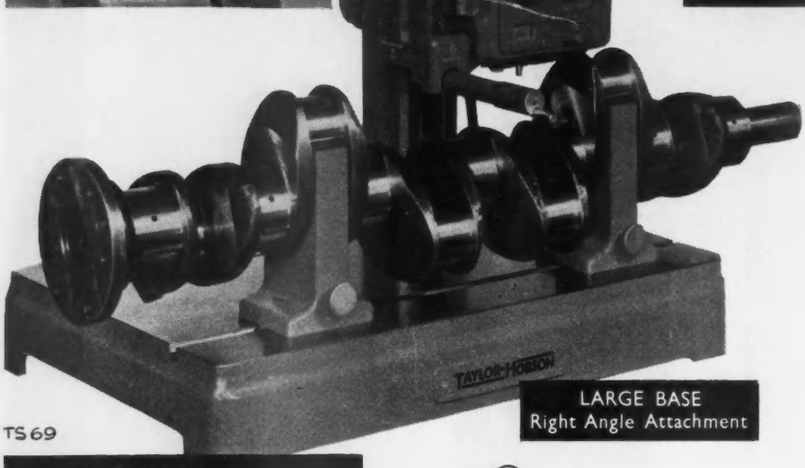

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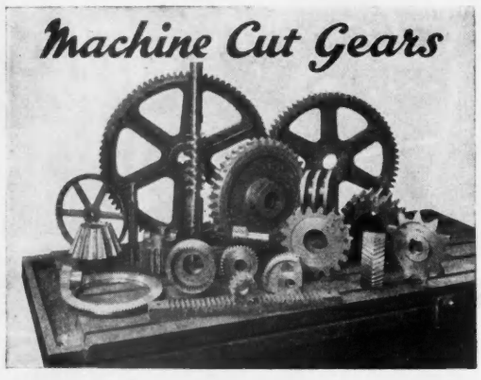

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Central Electricity Generating Board	Blyth 'B'	2450
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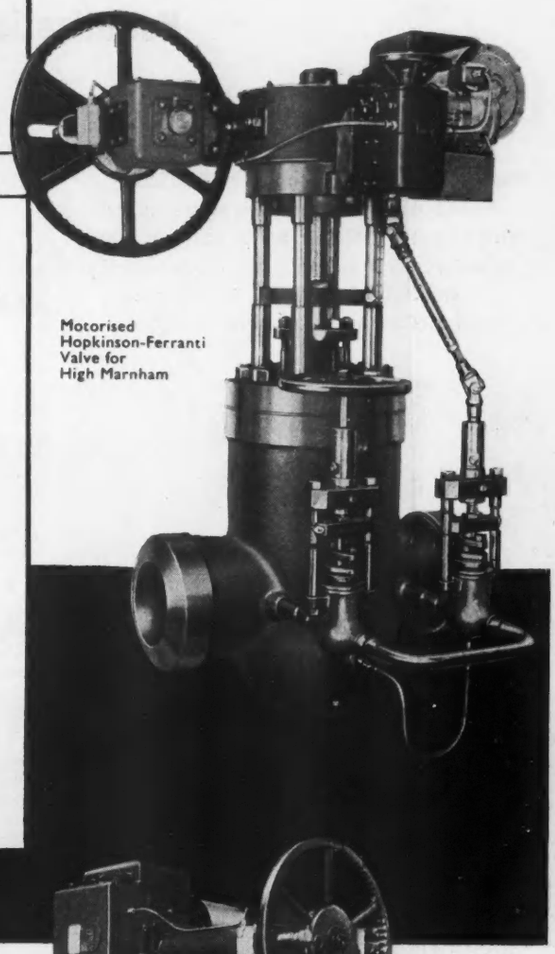

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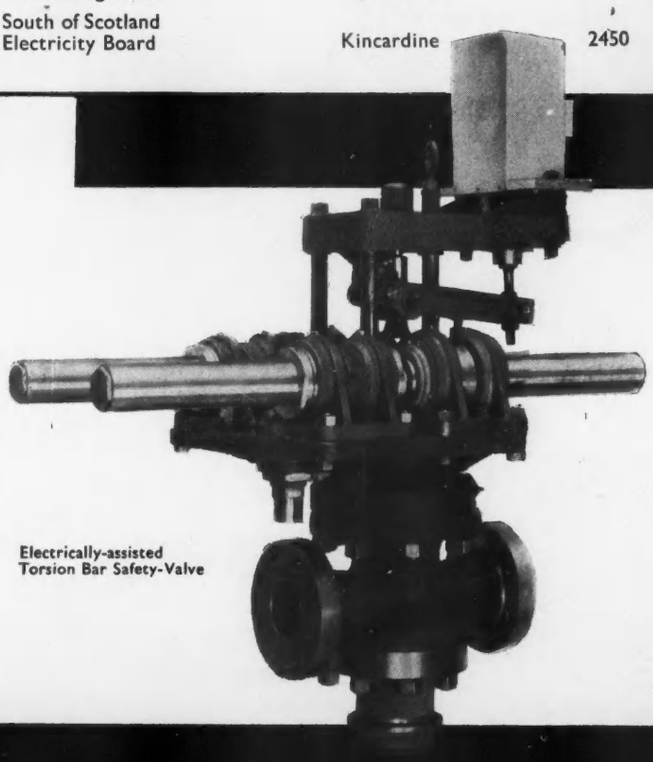

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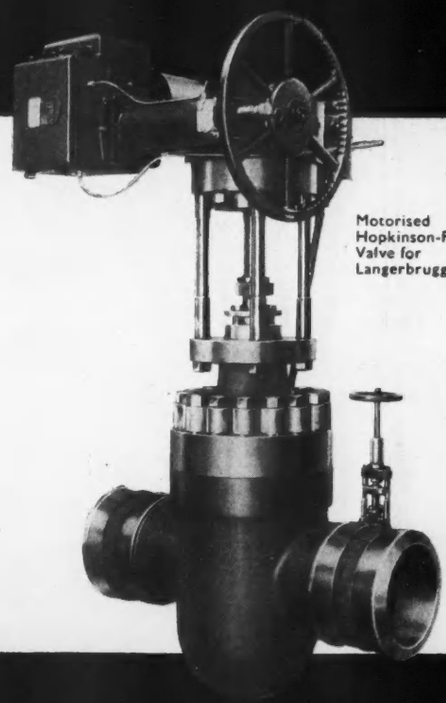

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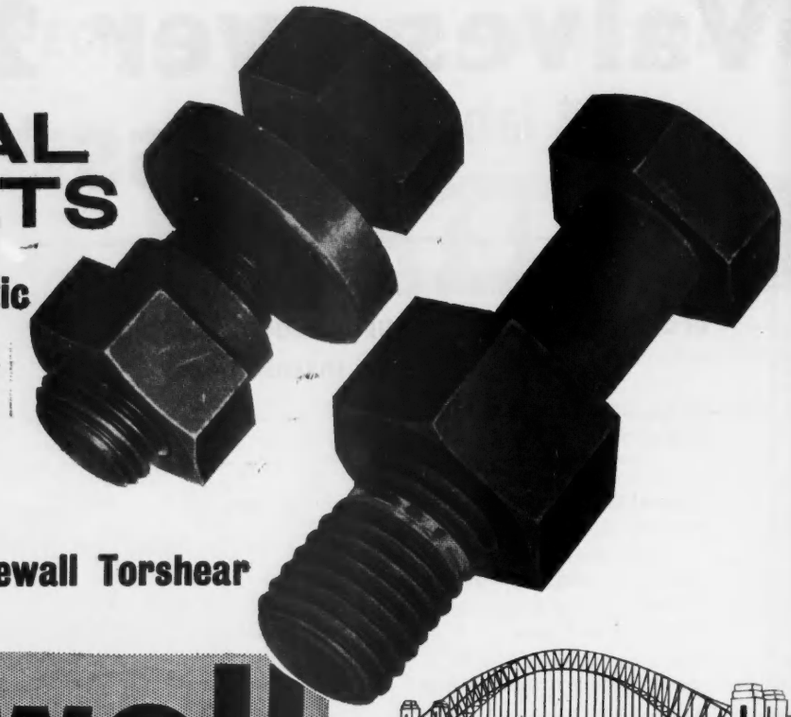

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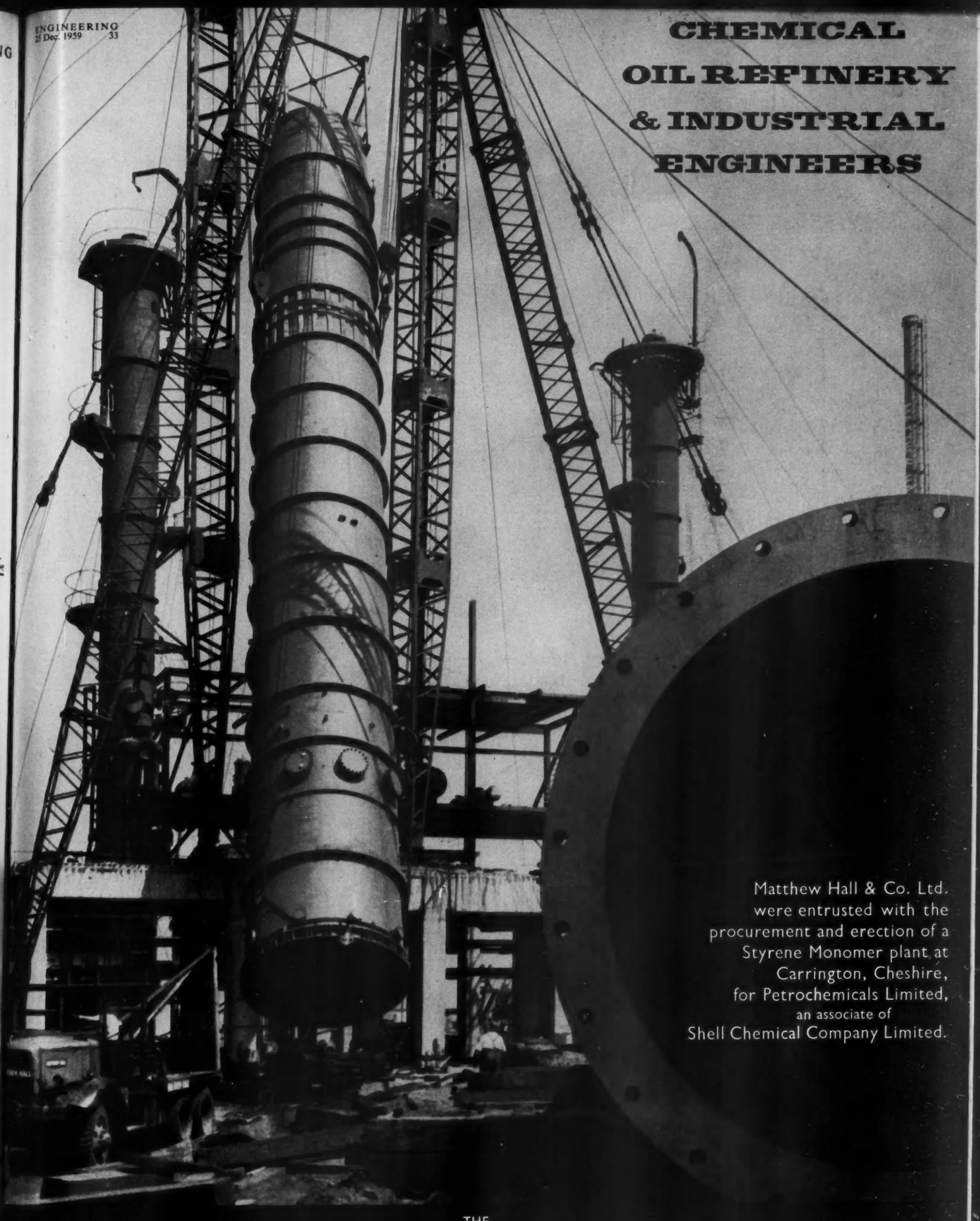

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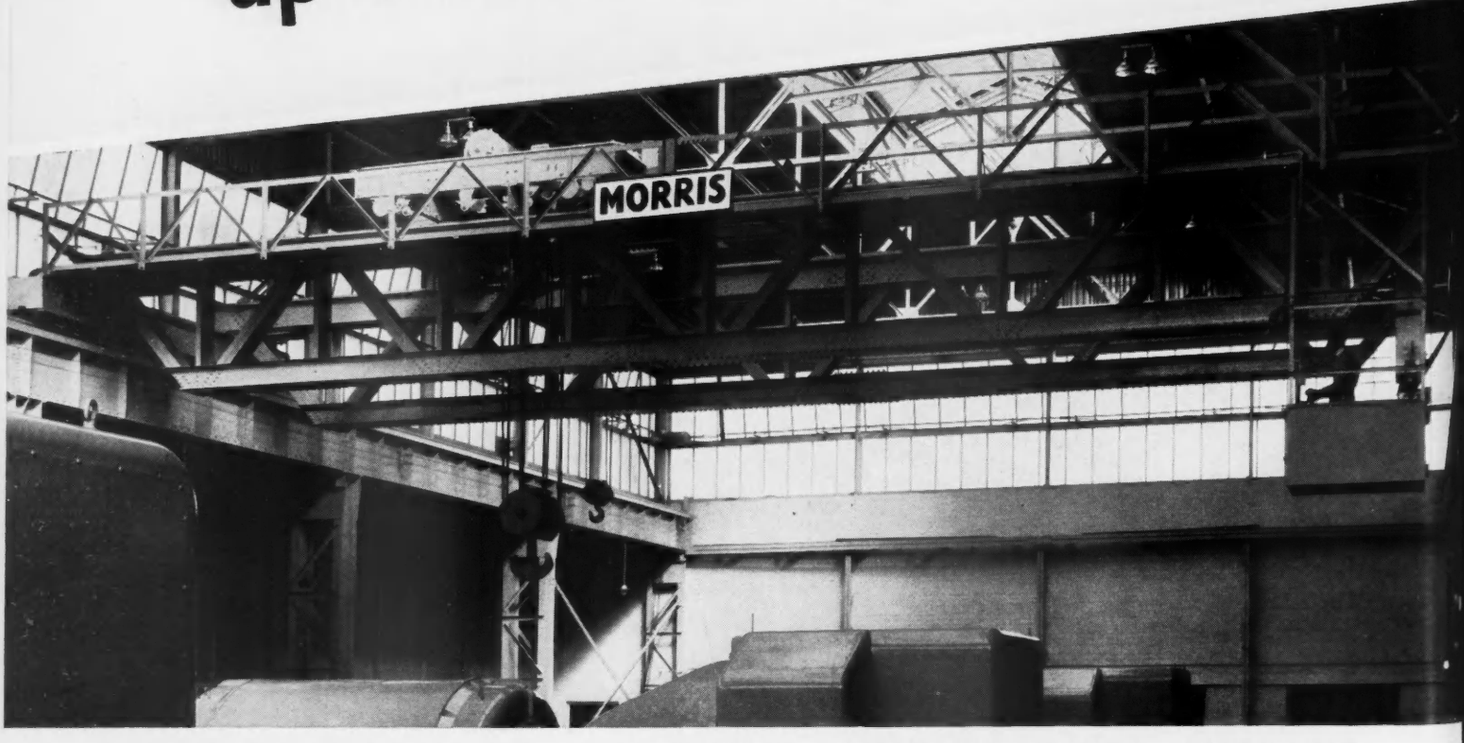

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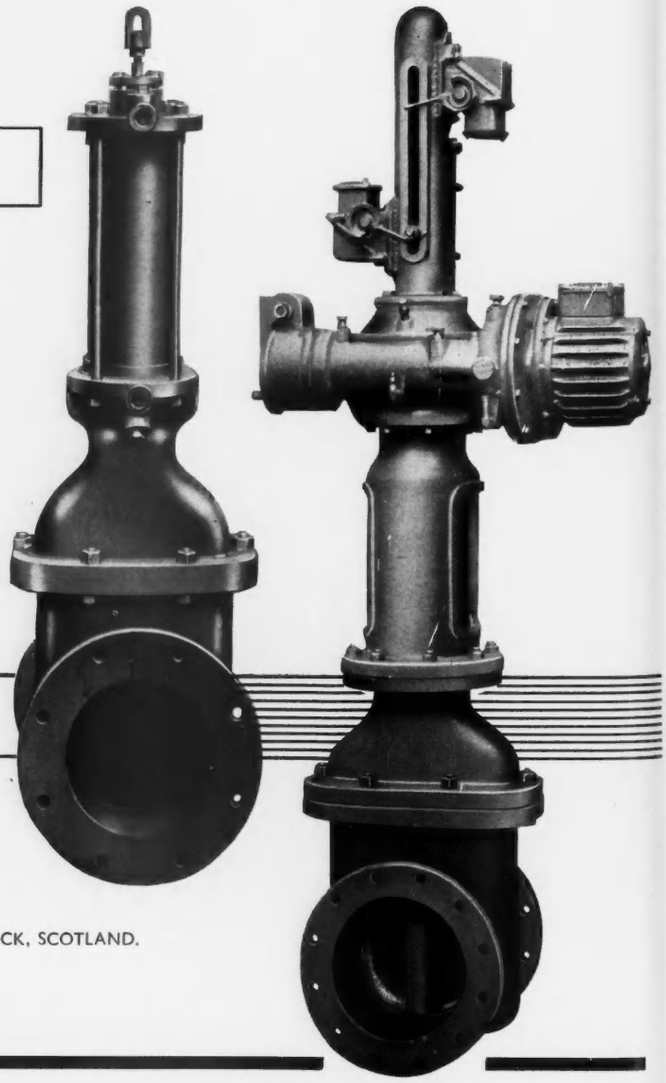

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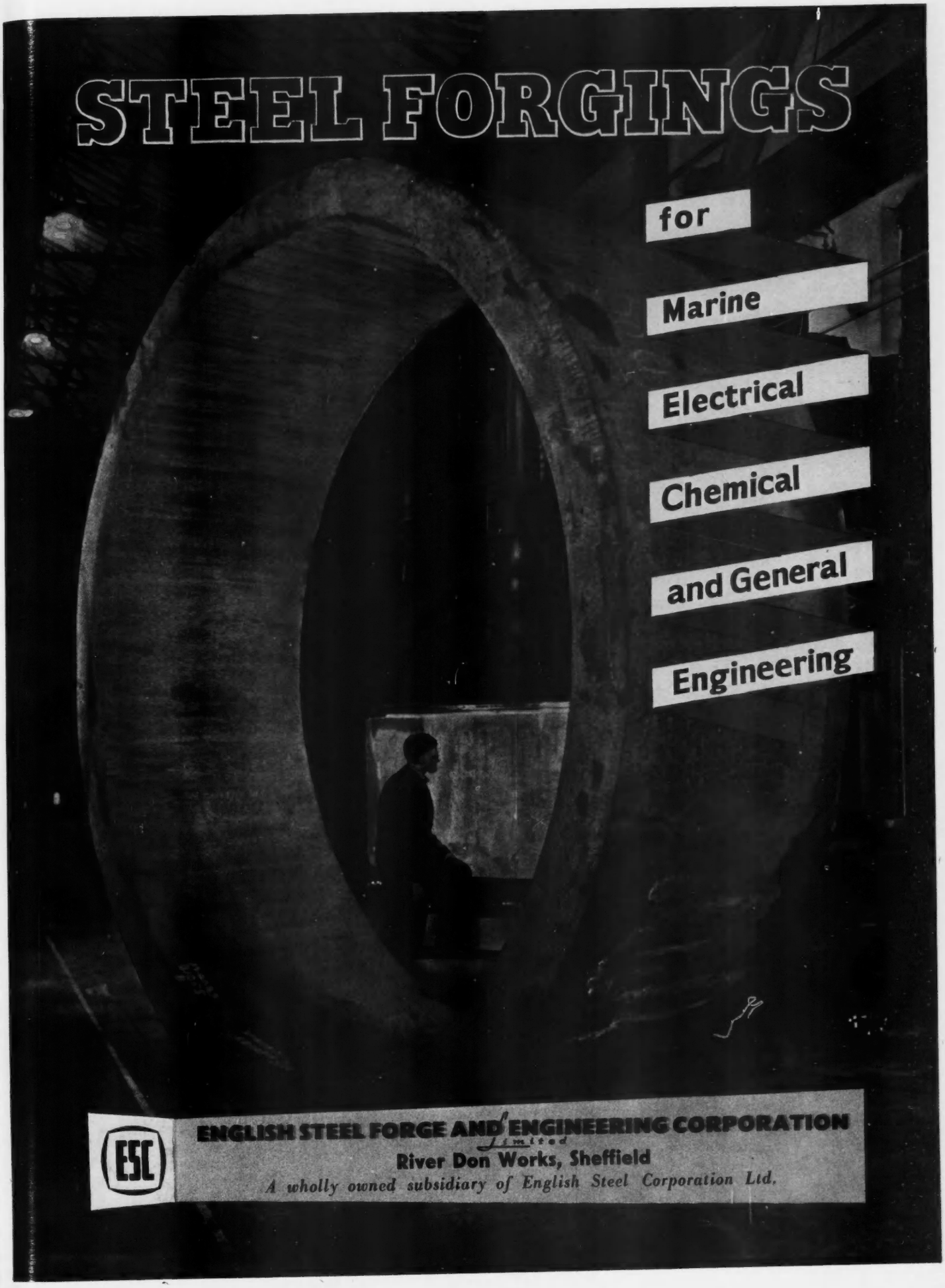
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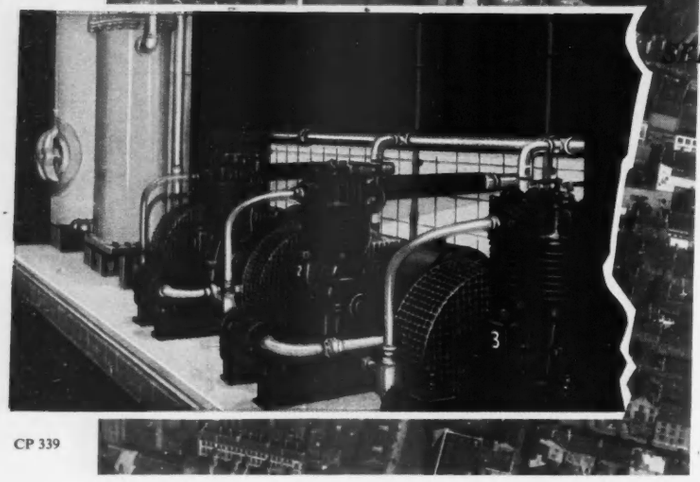

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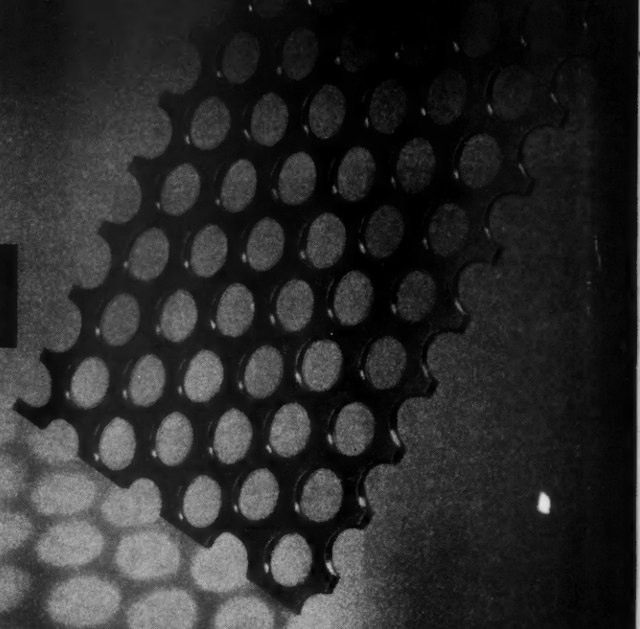

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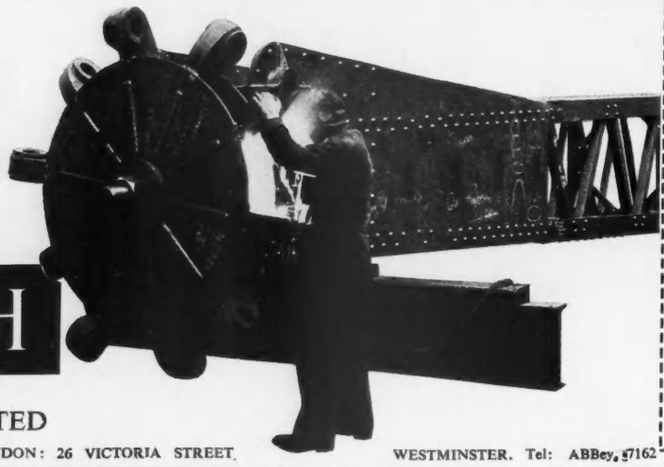

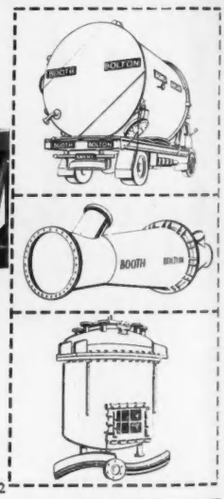

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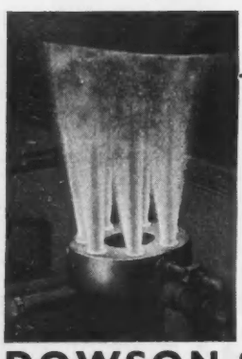

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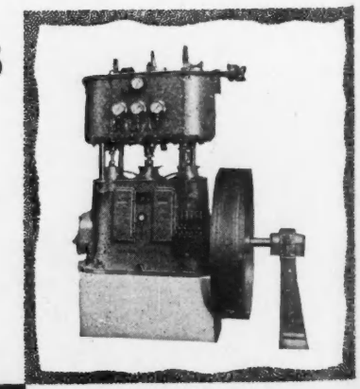

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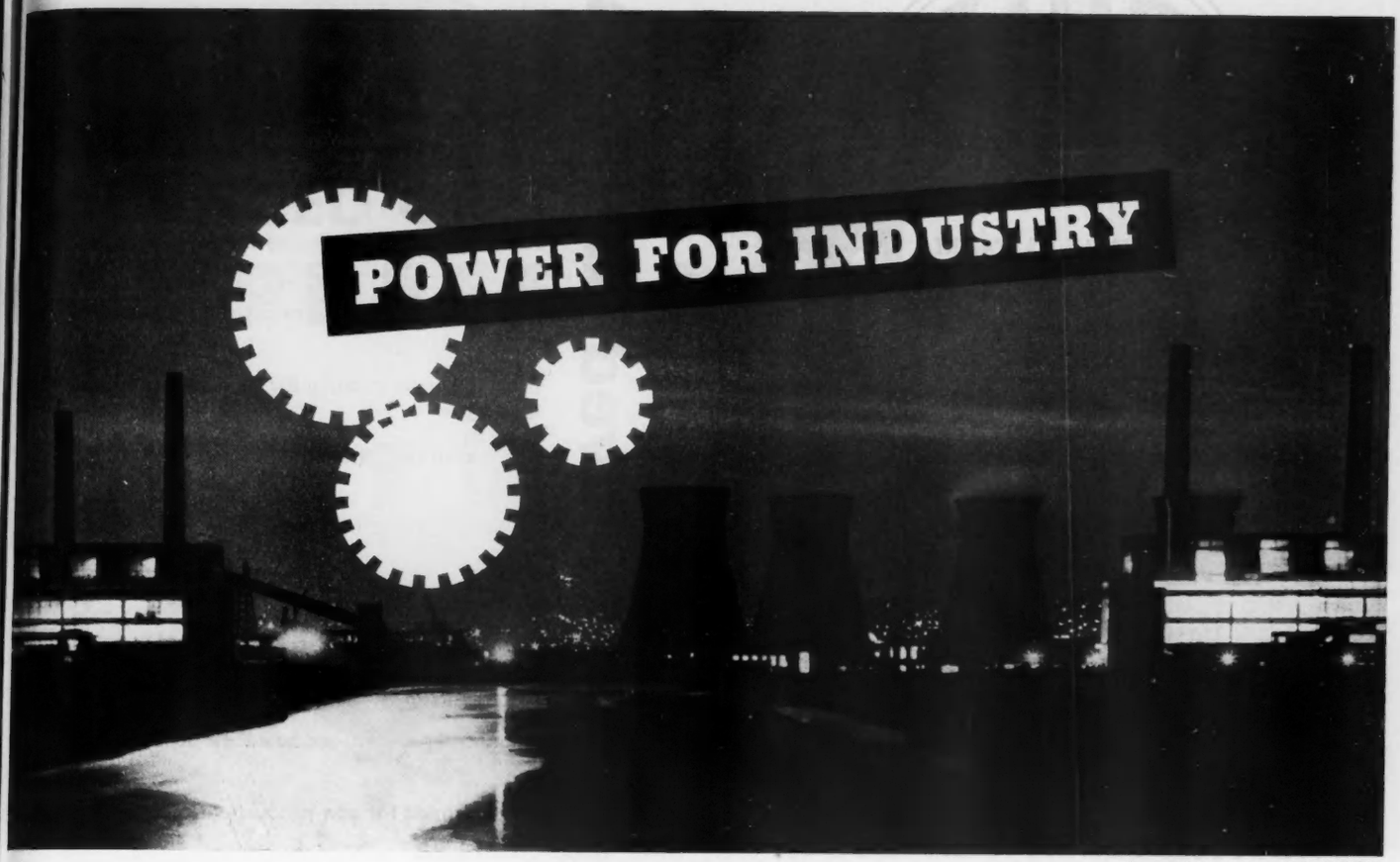

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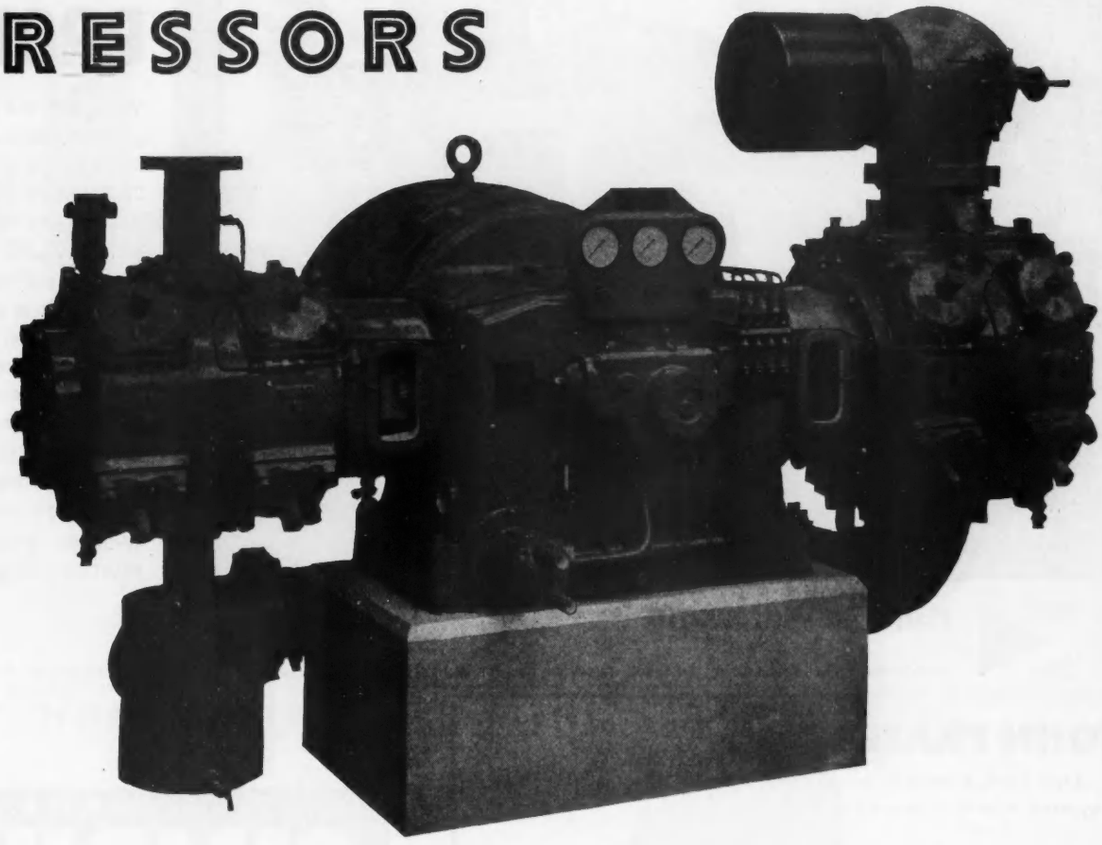

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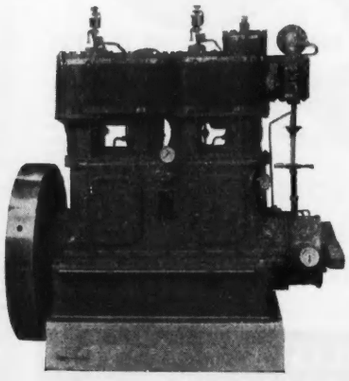

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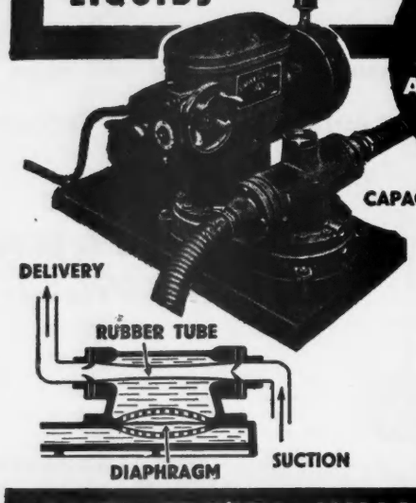
AND VISCOUS
FLUIDS



CAPACITY: ZERO TO 11 G.P.M.

The Simpulsic Pump incorporates a flexible tube of chemical - resisting rubber through which the liquid to be pumped is forced by alternate pressure and suction impulses At each end of the flexible tube there is a simple non-return valve of chemical-resisting rubber, and the end connections are of ebonite, designed to receive flexible rubber pipes. The pumped liquid never comes into contact with any metal parts and is handled throughout by chemical-resisting rubber.

AMES CROSTA MILLS & CO. LTD.
HEYWOOD · LANCASHIRE.

AT BLYTH 'B'

Two 'Boby' Feedwater Heating Deaerators are to be installed-capacity 1,850,000 lb/hr. each-in conjunction with two English Electric 275 MW turbo alternator sets

Central Electricity Generating Board Power Station

Main Turbine Contractors—
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WILLIAM BOBY
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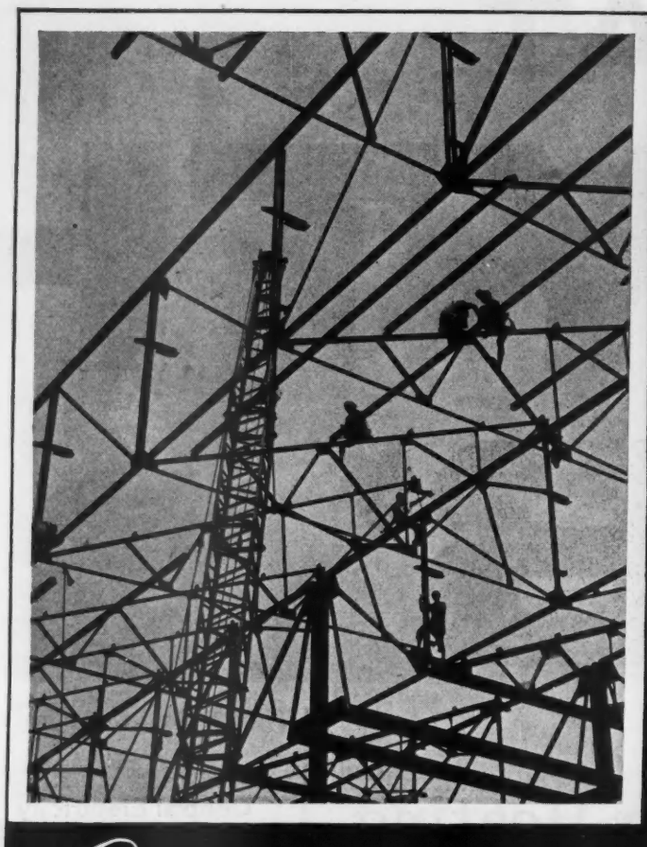
Established in 1875



LOCATION—
Durgapur—India

In course of erection is shown the lattice girders and roof trusses to the Light and Heavy Machine Shops and Loco Repair Shops for the Central Engineering Maintenance Department of the Durgapur Steel Project.
These form part of one of the several buildings of which the steelwork has been designed, fabricated and erected by CLEVELAND.

Construction by **CLEVELAND**

THE CLEVELAND BRIDGE & ENGINEERING CO. LTD. DARLINGTON, ENGLAND.

Printed by HARRISON & SONS, LTD., by Appointment to H.M. The Queen, Printers, London, England. Published by ENGINEERING LTD., at 36 Bedford Street, London, W.C.2

(ah! thats better)

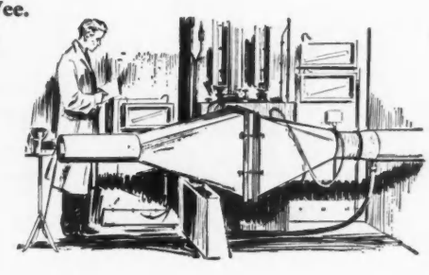
...Vokes *Super-Vee** Air Filter

the new, low cost panel that combats atmospheric pollution better than any other filter of its type

Vokes new Super-Vee panel is an inexpensive, expendable air filter employing a unique synthetic fibrous medium impregnated with newly developed adhesive. This medium is free from fibre migration unaffected by moisture, and will not crack: it is supplied in flame resistant form. The development testing of the filter to BSS.2831 revealed that the dust-holding capacity for a given rise in pressure loss, with no drop in efficiency, exceeds that of any other filter panel of this class. Size for size with similar filters (with which it is fully interchangeable) the Super-Vee offers up to 25% greater capacity thereby considerably reducing the number of panels needed for any particular application, allowing a more compact installation *and* lower maintenance costs.

Vokes Super-Vee, with its sustained efficiency under severe smog conditions, is the best low cost, long life expendable air filter for paint finishing plant, chemical laboratories, textile plant, distilleries, nuclear power plant and most heating and ventilating applications.

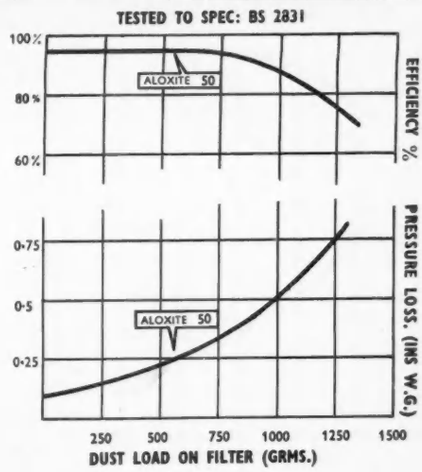
Please write for full information about the super-Vee.



METAL HOUSING FRAMES

These frames, for both front and side withdrawal, facilitate the removal and replacement of cells and the formation of banks of multiple units.

Full details are given in Vokes Installation Frames catalogue, sent on request.



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*Registered Trade Name World Wide Patents Pending

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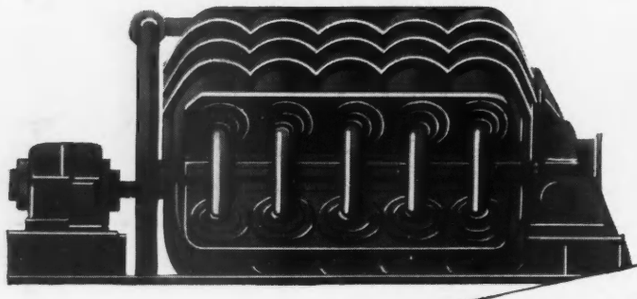
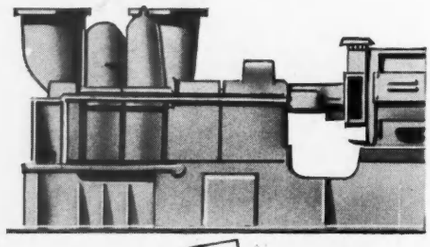
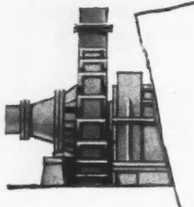
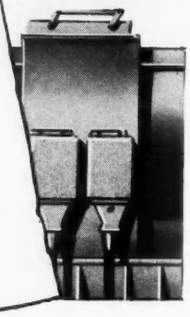
Centrifugal Compressing Plant

OF EVERY SIZE-OF EVERY TYPE









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Competitive prices: early deliveries.
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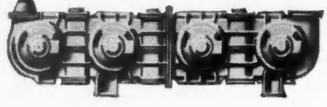
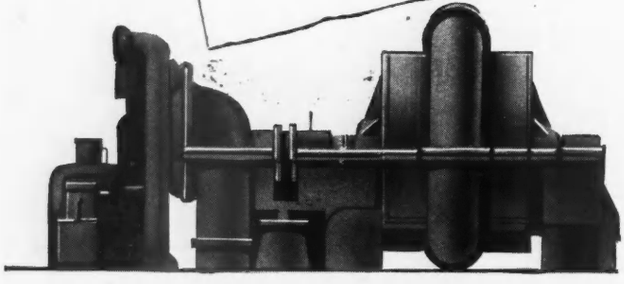
For information on any compressing plant problem telephone **RUGBY 2121** Ext. 363





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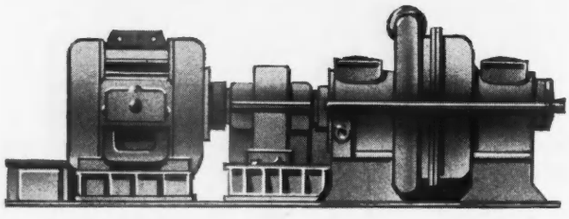

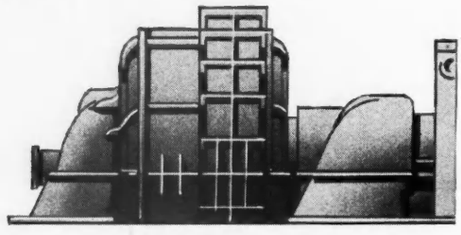

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